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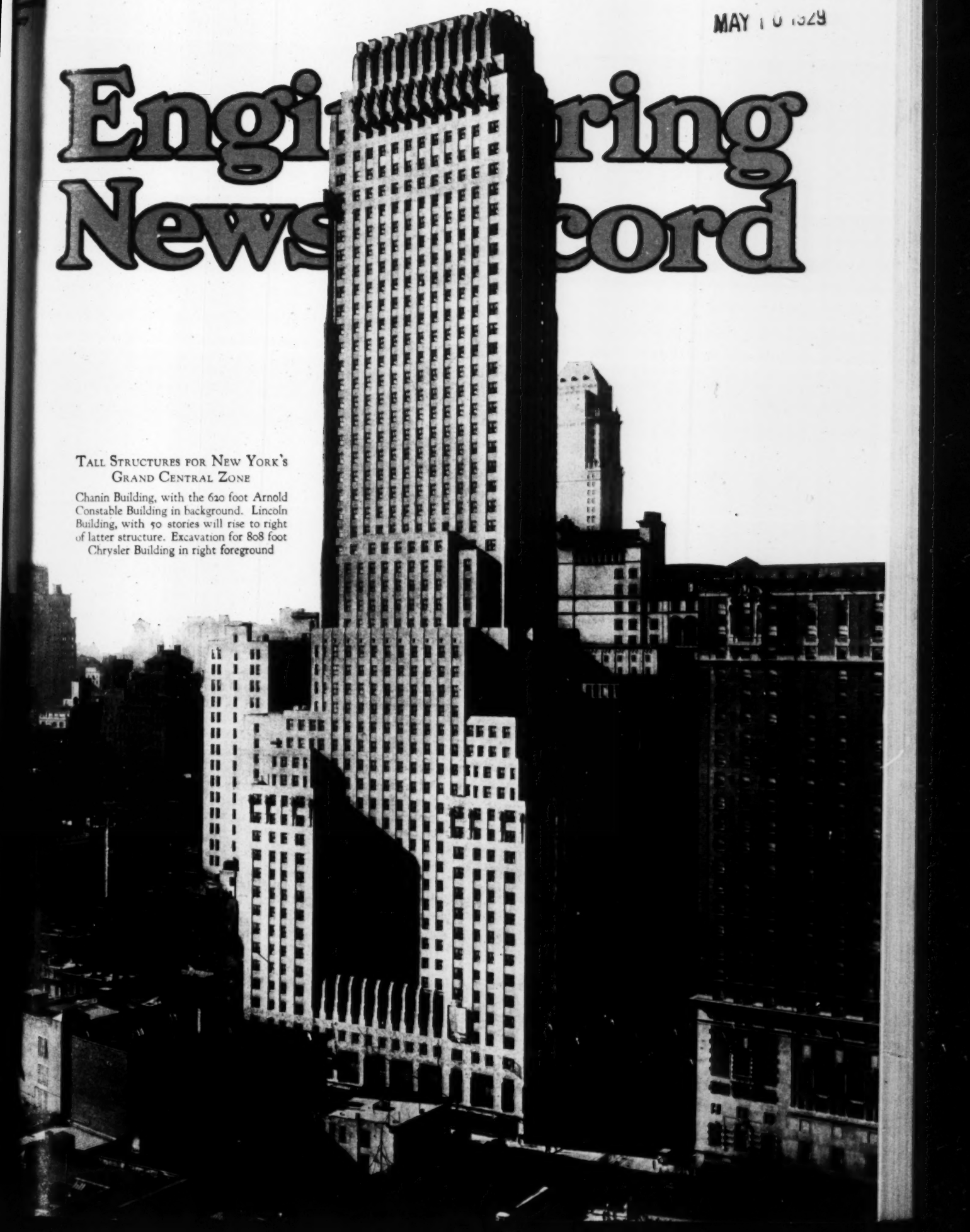
Engineering News-Record

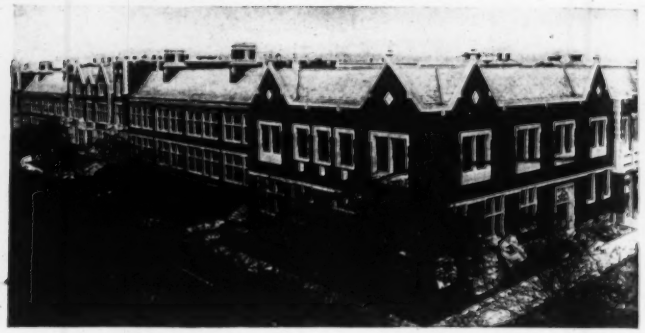


Tall Structures for New York's Grand Central Zone

Chanin Building, with the 620 foot Arnold Constable Building in background. Lincoln Building, with 50 stories will rise to right of latter structure. Excavation for 808 foot Chrysler Building in right foreground

Nailing Slate directly to roof-deck of Federal Nailing Concrete Slabs on a community building.

FEDERAL Nailing Concrete ROOF SLABS



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New York, May 9, 1929

Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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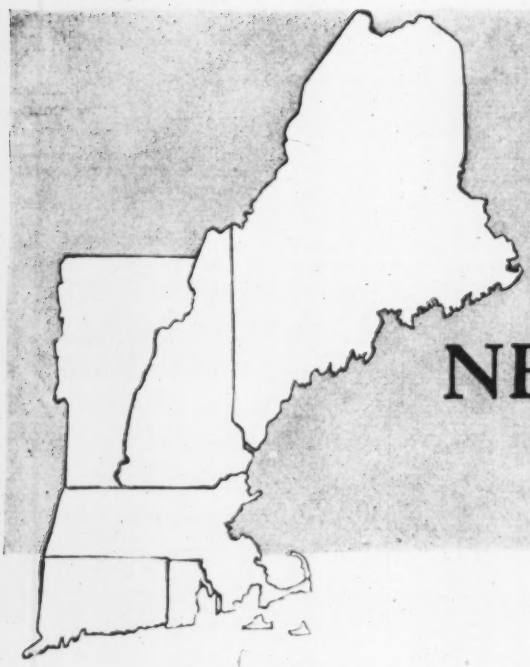

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Volume 102 NEW YORK, MAY 9, 1929 Number 19

Work Worth Doing

SOUND common sense was manifested in the annual meeting of the U. S. Chamber of Commerce last week. The organization, now 17 years old, gave less attention than in past years to trying to help the government to govern, and devoted itself more largely to studying the internal difficulties of business. The problem of how to carry on business more efficiently represents an ever wider field for cultivation, as the tremendous evolution of production and distribution constantly raises up more difficult questions. Despite the perplexing puzzles which grow out of the uncanny rapidity of scientific advance, despite the urgent political questions which spring from the closer inter-relation of the world, there are even greater potentialities of trouble or of smooth and peaceful progress in the economic effect of business changes. The Chamber, therefore, has every reason to center its activities on careful study of these changes, in order to find the proper adjustment of the several elements of the business structure before a serious unbalance is created. Business is still highly inefficient, as Dr. Julius Klein brought out strongly in a public address a few days ago, when he reckoned the losses due to business inefficiency at many billions per year. Let this estimate be discounted as much as desired, yet it indicates that the prime mission of a centralized council of industry and commerce is to make business more efficient and more farseeing. The extent to which this view has gained ground in the Chamber, as shown by last week's meeting, is most promising. Reducing the wastes of production and distribution and forestalling disturbance of the country's economic life is work well worth doing.

Some Current Examples

CURRENT events bring forward some impressive examples of business problems that are of public concern. In part they reflect progress toward clarification of national principle, and in part they raise up questions whose answers will have to be found in the future. In the former category is the final success of the efforts to enforce the authority of Congress in the promotion of honest business methods, as represented by the imprisonment of Harry F. Sinclair, the oil man, for contempt of the Senate. It will tend to clear the atmosphere. A second significant event is the initiation of new action in Congress on railroad consolidation. A bill has been offered which is designed to permit of voluntary consolidations provided they include the weak lines in the territory affected, on the ground that such equalization of railroad burdens is the real objective of consolidation—a progressive view. A third incident is the discovery by the Trade Commission of money dealings between a chain of newspapers and a paper manufacturing corporation interested in power as well as paper. In view of the common practice of a supplier helping to finance a customer, it may be held to violate no ethical principle; but it carries a grave threat to the integrity of the press and its freedom from biasing influence. A fourth is the introduction of the five-day week into the building field in New York, an event of great meaning to the whole industrial community, as indicated in another column. These several events show that if thought on some of our national business economic problems is clearing, many new problems are being created. Their solution presents a continuing opportunity for fruitful work by the organized agencies of the business community. The Chamber of Commerce has no lack of work ahead.

Public Responsibility

RECENTLY a national committee was named to draw up adequate provisions for state supervision of dam construction and maintenance. That this work is needed finds new illustration in the failure of a small dam in Northern New Hampshire after heavy rainfall. To speak charitably, such a failure is quite unnecessary. Dams are specifically intended to be safe under both normal and abnormal stream-flow conditions, and it is the manifest obligation of those who build them and those who permit their building to see that the same full safety is maintained permanently. Anything less than fully maintained safety is inexcusable negligence. Forty years ago a neglected dam in Pennsylvania failed when the heavy flow of water from a storm found the spillway partly blocked; the ever-memorable Johnstown flood was the consequence of this neglect. Since that time Pennsylvania has carefully recognized its duty to watch over the continued safety of existing dams, and many other state governments have adopted the same practice, but not all are as yet sufficiently conscious of their public obligations. Experience showed long ago, in oft repeated instances, that the interest of the owner of a dam is not always a sufficient safeguard, and in any event may not endure for all time, so that neglect of some requirement of safety must always be considered possible and even probable. Accordingly, the principle is now well established that watching over the safety of dams is a prime duty of the public authorities. If the work of the Engineering Council's committee can strengthen their watchfulness it will be public service indeed.

Power from Maine

IN SEPTEMBER the Maine electorate is to vote upon a proposal to modify the law which for years has prohibited the export of electric power from that state. Under the new law surplus power may be exported, subject to an excise tax. Maine, with great natural resources in water power, years ago began to fear that if power could be exported from the state, power would be sent out to industries outside the state, although the

state would like to have the industries come to it for power. The state legislators had a vision of the state becoming a great power station with few industries. But the industries did not come, and as the local demand was limited little power was produced. Industries which might have developed did not develop, because power was not being produced in quantities sufficient to make it cheap. Now the legislators have decided to let down the bars, but in order to gain favor for the export proposal a provision has been written into the law which requires the payment of an excise tax on the power exported. The constitutionality of such a tax is seriously questioned, and the legislators therefore wrote in the proviso that if any part of the law was declared unconstitutional the whole law would become void. Such a proviso, of course, tends to destroy the efficacy of the law, and the prospect of a change in Maine's historic attitude toward power is made remote. It may be, however, that while the matter is up for discussion the public will be educated to a point where the excise tax provision will not be needed to get majority support for the proposition if resubmitted.

Scientific Co-operation

NEWS that the Bureau of Standards is to undertake a searching investigation into the mysteries surrounding the condemned cable wire of the Mount Hope and Detroit suspension bridges is welcome indeed. It is true that the necessity of the announced course of action was unmistakably obvious since the safe growth not alone of the bridge building art but of every industry and every department of our national government that has occasion to use metallurgical knowledge was involved. Yet, for a time there was grave danger that, in the natural rush of tasks incident to dismantling and re-erecting the bridges, the broad question of determining causes for the failures in the cable wire would be slighted. It is also gratifying to note the hearty co-operation being accorded the bureau by all parties concerned. The engineers of the Mount Hope Bridge Company, who from the first have displayed an attitude toward the subject that is a credit to the principles upon which the civil engineering profession is based, have offered help in the fullest measure. The cable manufacturer has come forward with a promise of utmost assistance in searching out the causes of failure. Thus, so far as the parties connected with the bridges in question are concerned the bureau is assured of all necessary help and data. The problem to be studied, however, is of a kind demanding the co-operation of the best equipped investigators and scientists in the field of metallurgy regardless of their affiliations, and as the purposes to be served by the investigation are of basic value to the bridge art it will be helpful to utilize the full co-operation of technologic and scientific authorities in this field. The nature and importance of the inquiry fully justifies the broadest possible scientific co-operation perhaps by the formation of a board of consultants composed of wire and steel students and technologists to advise with the bureau on the methods and scope of the investigation and to interpret the results. With such a promising beginning as the bureau has made by interesting itself in the problem, nothing should be left undone which might cause some of the potential sources of trouble in the wire to be overlooked. A well considered plan of complete scientific co-operation will be of value in assuring this end.

Bridges and the War Department

DURING the last year or two, the attitude of the Chief of Engineers of the U. S. Army, who by law is charged with the duty of passing on plans for bridges over navigable waters to see that they do not interfere with navigation, has favored much greater bridge clearance heights than have been accepted as sufficient heretofore. In a number of cases heights approaching 200 ft. have been demanded, though there is no present shipping need for any such height. It is true that larger ships are in prospect as evidenced by construction in Europe of two great drydocks larger by far than any in the United States. But the supposition that larger ships require increased funnel and mast heights is open to serious doubt.

On this point of clearance height the attitude of the War Department has been so sharply crystallized, and is so extreme in its manifestations, as to suggest at times that the Army engineers desire wholly to prevent the construction of bridges over major waters, regardless of the needs of land traffic. As reported in the current week's news pages, the Chief of Engineers has arbitrarily taken upon himself the authority of vetoing the construction of bridges in large ports, as the Hero-Hackett bridge in New Orleans. Indeed in all forms of conflict between navigation and land traffic, the War Department unfortunately has long been in the position of a partisan for the navigation interests. To some extent this position is natural, for all applications whether for new bridges or for methods of operation of existing ones come before the department with plans contemplating minimum requirements, and it is inevitable that the office of the Chief of Engineers should take an opposite view. But in thus representing and defending the interests of navigation, it is highly unfortunate if an approving authority vested with so much power as is the office of the Chief of Engineers commits the error of forgetting its judicial obligations and become as thoroughly partisan as those who submit applications. That this was the case where restriction of drawbridge openings was in question has come to be a matter of widespread popular belief, and the recent veto of bridge application as well as the raising of requirements for bridges over major waterways to a clearance height approximating 200 ft. tends to confirm this opinion.

Bridge clearance heights over large streams and harbor entrances have hitherto ranged from 135 to about 160 ft., and have succeeded in meeting all demands of navigation. That mast heights of some sailing vessels exceed these limits, and that it is quite possible to erect similar tall masts on steamships for signaling or radio purposes, has not been a source of difficulty and consequently does not constitute a reason for undue extension of bridge clearance heights. Topmasts that can be lowered quickly and easily are widely known devices, and can be applied without trouble or great cost where high masts are wanted for some purpose or other.

Funnel heights of large steamers present a more serious case, since they are necessarily fixed structural elements. These, however, have never been found to involve of necessity any abnormal heights, many of the high funnels on existing ships being the result solely of architectural judgment. It is quite possible, therefore, that by whim or arbitrary variation the funnel height of some particular vessel may be further increased over normal or necessary practice, and it would be plainly absurd to attempt to raise the height of all major bridges

throughout the world to accommodate such construction. The truly logical basis of a clearance height limit must obviously be a survey and judicious forecast of actual necessities of future ship construction, rather than some expectation as to heights that the arbitrary designs of naval architects may at some future time produce. Such an analysis and forecast of the future, however, does not appear to have been made; at least, no suggestion of it is found in the various recent dicta of the Chief of Engineers' office insisting on abnormal clearance heights.

The point at issue is one phase of a fundamental defect in the administration of the law designed to protect the interests of navigation. The law establishes the Chief of Engineers as supreme judge in matters of conflict between land traffic and water traffic, but at the same time it makes of him a partisan of navigation demands and desires. An equitable disposition of questions placed before him is thereby rendered improbable.

The situation created by the exorbitant demands of the War Department for great clearance heights threatens to place a prohibitive check on the construction of large bridges. The situation is the more illogical and unsound because varying judgments from year to year prescribe different clearance heights, and lead to a nonuniformity that is of no benefit to shipping and imposes a repressive burden on all land interests. Clearance heights should be removed from the arbitrary action of an administrative bureau, and should be defined by legislative enactment by Congress, based on a thorough study of shipping requirements on the part of a competent commission.

Finally, in order to remove the Chief of Engineers' office from its untenable position of mixed judicial and partisan function, the bridge laws now existing should be revised to provide for placing all questions involving land and shipping interests before a tribunal so constituted as to assure representation of all the contending interests. Already has Congress in one instance taken control of bridge clearance questions out of the hands of the War Department, because of unwillingness to entrust a critical case to that department—the case of the Longview bridge over the Columbia River in Washington. Applying the same general principle a fair and just tribunal can be set up which, acting on specific definition of clearance heights by Congressional enactment, would assure adequate scope for development to both land and water transportation.

Speed Control

NEW YORK CITY has added another fatal accident to its rapid transit history as a result of the practice of permitting trains to pass the trip of an automatic train stop by a manual operation known as "keying by." And as a consequence the Transit Commission has ordered the rapid transit companies to discontinue the practice, except in emergencies, and only then when done by the motorman of the train passing the signal so that there can be no doubt of his being aware that he has entered an occupied block. With the system of train control in use on the rapid transit lines of New York at the present time this order is the only means of insuring safe operation, but in view of the fact that methods of train control have been improved greatly since the system was installed the order should not be taken as finally putting a stop to a practice which increases the capacity of the rapid transit lines.

The practice of keying by is not the outgrowth of careless operating methods, but of a well considered plan for speeding up traffic by permitting one train to close up on the preceding train at loading points. Its chief drawback is that it transfers responsibility for stopping a train at a safe distance behind the one ahead from a mechanical device to the motorman of the following train. And because it is resorted to frequently it dulls the motorman's sense of responsibility to the point where, when the keying by is done by some one outside of his cab, he may become almost unaware of its happening.

Modern systems of train control, as developed in recent years on the steam railroads, have provided against just such failure of the human element by installing on the train itself a speed control device so integrated with the signal system that it is inoperative when the train speed is greatly reduced upon approaching an occupied block and continues inoperative if the train enters the block at or below a prescribed rate of speed; but if that speed is exceeded within the block the power is shut off and the train brake applied automatically.

A similar system of speed control should be used on rapid transit lines such as those of New York where the maximum capacity is demanded at rush hours. By its use the closing up of trains at loading points could be done without the dangers involved in the present practice of keying by signals and depending upon the motorman to keep his train under control as he closes up on the train ahead.

The Five-Day Week

AN INCIPIENT change, one of the most far-reaching of recent times, received strong impetus a few days ago in the agreement of building trades employers and workers in New York City to adopt the five-day week. The agreement is an indication that the five-day week is likely to progress throughout all industry, foreshadowed several months ago when Henry Ford established the plan in his plants. Ford doubtless reckoned on increased efficiency of his force; and if this anticipation is borne out by the fact, it would seem inevitable that the system should spread.

The effect of the plan on building costs remains to be seen. In 1913 labor represented 38 per cent of the total cost of building; today the ratio has risen to 53 per cent. Undoubtedly the cutting of working time ten per cent without lowering the weekly wage scale will cause a rise in labor costs for the present. Whether this rise will be overcome by increased efficiency and additional mechanization is problematical. In the past the upward trend of labor costs has been somewhat compensated by increased speed in building, which resulted in cutting down investment charges. But there is a limit in this direction and not much further gain in speed can be expected to offset higher unit costs of labor. At all events, until contractors have determined the actual effect on labor costs, it is to be expected that bid prices will show the effect of the 40-hour week.

On present outlook the five-day working week is coming just as surely as the eight-hour day came. For the moment the New York City agreement does not appear likely to affect many outside circles other than by precept and example; but its influence in the latter sense is bound to be highly significant.

Structural Features of 626-Ft. Chanin Building in New York City

Railroad Bus Terminal on First Floor—Second and Mezzanine Floors Are Removable for Renting Flexibility—Erection in 3½ Months

By Laurence A. Ball
Consulting Engineer, New York City

FIVE YEARS AGO the average height of the new buildings in New York City that could be characterized as tall was about 35 stories. At the present time this average has risen to between 40 and 45 stories, and several buildings under construction which are in excess of 50 stories. Of these latter, the 56-story Chanin Building is the first to be completed; it was officially opened about Feb. 1. —EDITOR.

THE new Chanin Tower Building in New York, located on the west side of Lexington Ave., between 41st and 42d Sts., is 56 stories in height and rises 626 ft. from the sidewalk to the top tier of steelwork. In the solution of its structural problems rigid requirements for a maximum utilization of floor areas as usable space and for safe and rapid completion were guiding influences. The structural frame was erected in about 3½ months, erection being greatly facilitated by the design of the steelwork along simple and direct lines. Among the unusual features in the structure requiring special engineering and architectural study was the introduction of a bus terminal for the Baltimore & Ohio Railroad on the first floor of the 41st St. side and the provision for a private theater on the 49th and 50th floors. This theater is to be used for tryout purposes and has a seating capacity of 144. Both the stage and the auditorium are two stories in height.

The building is L-shaped in plan with a front of 175 ft. on 41st St., 197½ ft. on Lexington Ave. and 125 ft. on 42d St. The first setback occurs at the fifteenth floor on both 42d St. and Lexington Ave., above which by four successive setbacks the upper tower with a floor plan of 67x129½ ft. is reached at the 28th floor. The tower continues without setback to the top of the building.

All foundations are supported on Manhattan schist of tested uniform characteristics. In Fig. 2 is shown a typical grillage, steel shoe and column detail in the tower part of the structure. The shipping weight of the heaviest of these grillages was 28,000 lb. The heaviest column in the building occurs in the tower section and supports a total dead and live load of 5,012,000 lb. To sustain this load and to afford a minimum encroachment upon architectural clearances, a box column was used, made up of a 16-in., 365-lb. H-section with four 5x5x1-in. angles, two 14x¾-in. web plates, two 7x1⅞-in. reinforcing plates and two 28x3-in. cover plates, affording a total cross-sectional area of 28x23⅜ in. exclusive of rivet heads. The maximum shipping length for columns was 33 ft. 8 in. and the total shipping weight of the heaviest column section was 46,000 lb.

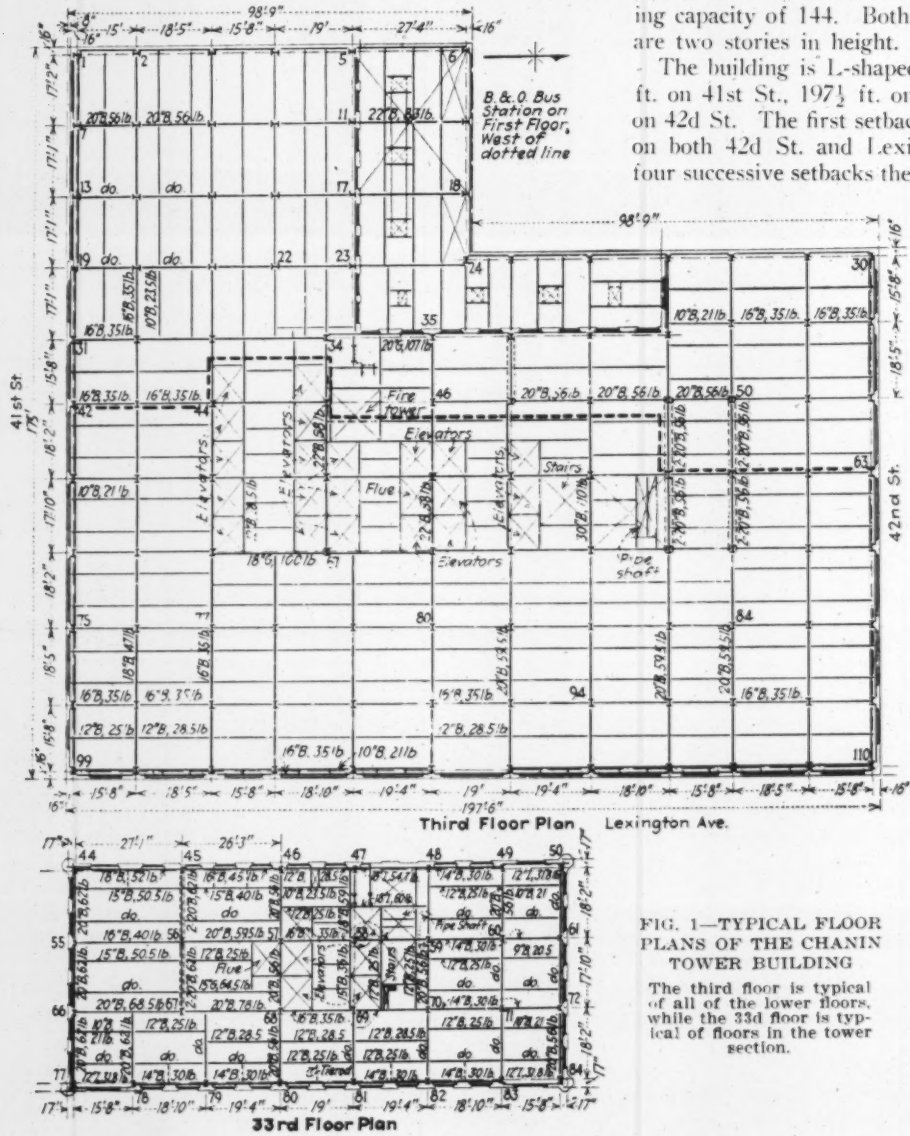


FIG. 1—TYPICAL FLOOR PLANS OF THE CHANIN TOWER BUILDING

The third floor is typical of all of the lower floors, while the 33d floor is typical of floors in the tower section.

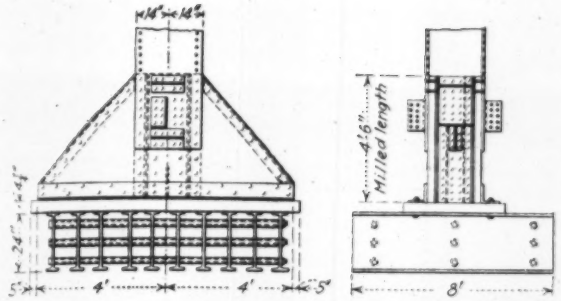
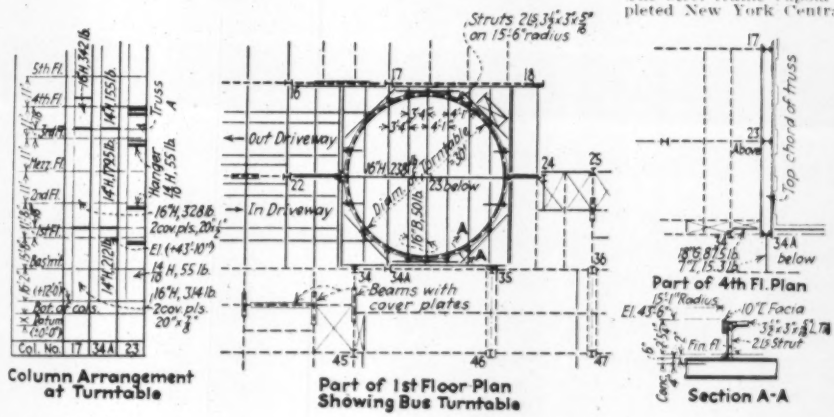


FIG. 2—BASE DETAIL OF HEAVIEST COLUMN SECTION

Bus Terminal—The bus terminal on the first floor includes ticket office, waiting rooms and a specially designed interior turntable for facilitating the necessary movements of the buses. The inside driveways leading to the turntable are of sufficient length for four buses; with one bus on the turntable, there are thus accommodations for five buses inside the building. The turntable (Fig. 3), which had to be constructed in a total depth of 2½ ft., is of patented design and 30 ft. in diameter. It is supported on a framework of 16- and 24-in. beams framing between the surrounding columns and in addition is carried at the center by a column from the basement. Above the turntable a truss with a 34-ft. span is inserted between the third and fourth floors, carrying the second floor from a 14-in. H-section hanger at its mid-

FIG. 4—SOUTH ELEVATION OF 56-STORY CHANIN TOWER BUILDING, NEW YORK CITY

The steel frame cupola to the left is on the recently completed New York Central Building.


Struts 2L 3½"x3½"x⅝" on 15'-6" radius
Out Driveway
In Driveway
Beams with cover plates
Column Arrangement at Turntable
Part of 1st Floor Plan Showing Bus Turntable
Part of 4th Fl. Plan
Section A-A

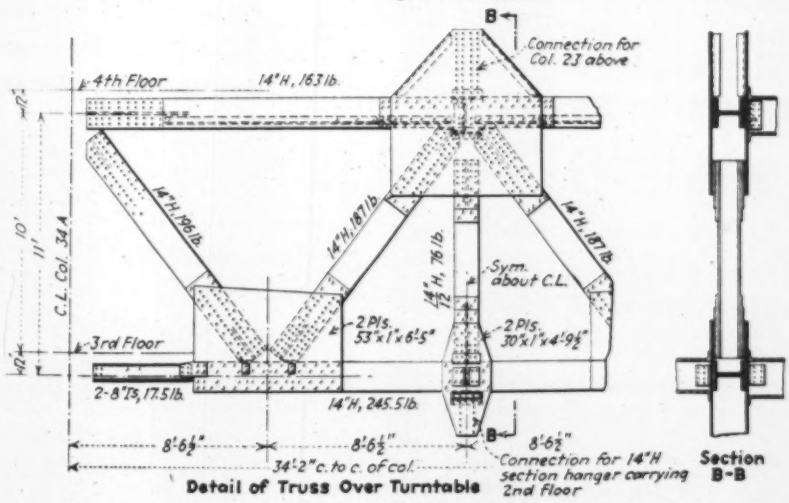


FIG. 3—STRUCTURAL DETAILS OF TURNTABLE ARRANGEMENT IN BUS TERMINAL OF CHANIN BUILDING

Column 23 is eliminated between the first and second floors and is supported from the second floor upward by the truss placed between the third and fourth floors.

point. This truss also supports the continuation of column 23, which was discontinued at the center of the turntable in the first floor. The ordinary column spacing of approximately 17 ft. on the first floor permits the inclusion of the driveways without undue alteration of the structural frame.

Provisions for Wind — The typical and prevailing transverse windbracing connection is made by stubs of two 24-in. 115-lb. standard beams with each flange shop-riveted to the columns with eight 1-in. rivets and their flame-cut webs field-riveted to the flange of 22-in. 58-lb. beams with ten ⅞-in. rivets. In addition, a minimum 8x8x½-in. web angle is included to take the vertical shear. In the longitudinal direction the typical and prevailing windbrace connection is made up of the stub of two 15-in., 55-lb. channels with each flange shop-riveted to the columns with four 1-in. rivets, and their webs field-riveted to 16-in., 35-lb. beams with six ⅞-in. rivets. In these connections a web angle is also used when necessary to take the vertical shear.

Special sway bracing is provided in a transverse direction as shown in Fig. 5. Two 12-in.

channels are used for three bents in the lower stories and two 10-in. and 8-in. channels for two bents in the upper stories. This vertical sway bracing was necessary to secure a proper balance of windbracing connections about the transverse neutral axis, in order to assist in reinforcing the building against any torsional action from wind stresses which might come upon it. All of these sway bents are installed in partitions free from interruption with doorways and other openings. All wall spandrels are also braced by top and bottom angles. In the tower portions of the building, the spandrel beams are located on the center line of columns and small channels are

ers had to be provided in many cases in the first and third floors in order to afford sufficient strength for resisting the bending stresses and at the same time to enable an adequate connection to be made to the columns. All column connections in the second and mezzanine floors for girders which may be subsequently omitted have been designed so that they can be removed without resorting to flamecutting. This farsighted policy on the part of the owners in arranging for the second or mezzanine floors to be removable, has enabled them to make several important and valuable leases which otherwise would have been impossible. One of these leases re-

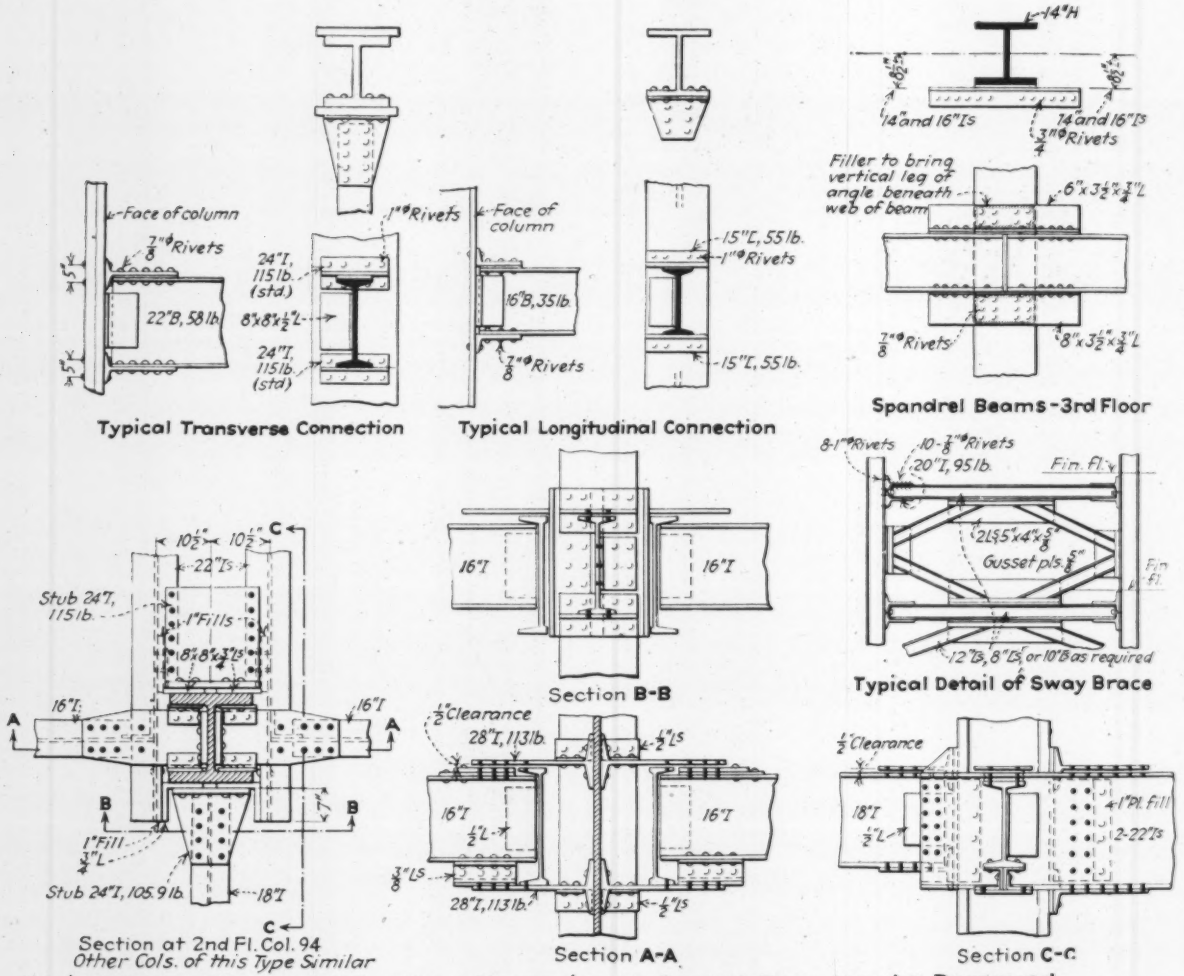


FIG. 5—TYPICAL WIND CONNECTIONS IN CHANIN BUILDING

used and bracketed out from the webs of the spandrel beams in order to support the exterior walls.

The heaviest and most special wind connections occurred in the lower stories, where, in order to make renting conditions for business interests requiring high story heights as elastic as possible, the building was designed so that transversely and longitudinally either the second floor or the mezzanine, which is between the second and third floors, could be omitted in the rentable portions of the building. Thus heavy windbracing was provided where necessary in case these alterations should ever be required. In making provision for the omission of the windbrace girders between these two floors, double girders had to be provided in many cases in the first and third floors in order to afford sufficient strength for resisting the bending stresses and at the same time to enable an adequate connection to be made to the columns. All column connections in the second and mezzanine floors for girders which may be subsequently omitted have been designed so that they can be removed without resorting to flamecutting. This farsighted policy on the part of the owners in arranging for the second or mezzanine floors to be removable, has enabled them to make several important and valuable leases which otherwise would have been impossible. One of these leases requires the suspension of a vault weighing a total of 125 tons from the mezzanine floor.

The floor system used throughout the building consists of 4-in. cinder concrete arches with a maximum span of 8 ft. and reinforced with wire mesh. Floor loads in all of the office portions above the mezzanine floor were calculated for 60-lb. live load exclusive of partitions. All floors below this point were calculated for a live load of 100 lb. per square foot excepting the stores on the ground floor, where 120 lb. per square foot was used. The 49th and 50th floors on which the theatre is to be located, were designed for a live load of 100 lb. per. sq.ft.

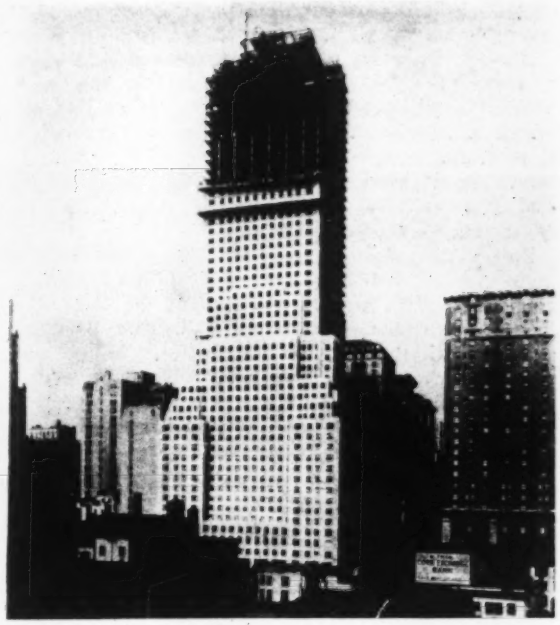


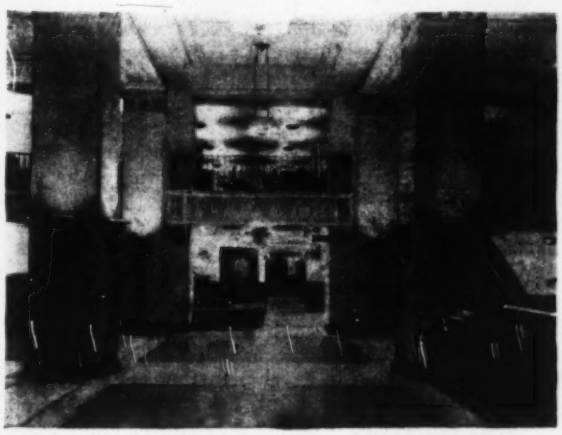
FIG. 5—EAST ELEVATION OF CHANIN BUILDING DURING CONSTRUCTION

The owner and builder of the building is the Chanin Construction Company. The structural design was executed by Ball & Synder. Sloan & Robertson were the architects, and steel erection was carried out by the Levering & Garrigues Company. H. G. Balcom checked the steel plans and inspected the steel work. Clark, MacMullen & Riley were consulting engineers for the mechanical equipment.

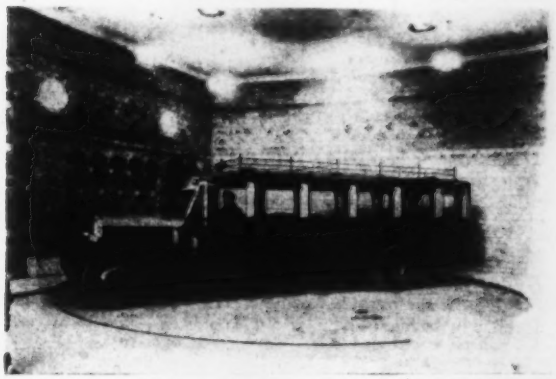
Unique Railroad Bus Terminal in Chanin Building

A RAILROAD passenger terminal unique in railroad history was opened recently by the Baltimore & Ohio Railroad in the Chanin Building in New York, which is described in the preceding pages. It is in fact a bus terminal for passenger buses operating between the Grand Central zone and the railroad terminal of the Central Railroad of New Jersey in Jersey City, N. J.

For something over a year the Baltimore & Ohio Railroad, which operates its through trains into the Jersey Central terminal in Jersey City has been operating



INTERIOR OF THE B. & O. BUS TERMINAL



A BUS BEING TURNED ON THE TURNTABLE

buses between that point and two bus terminals in New York City, one in the Waldorf-Astoria Hotel and the other in the Pershing Square Building opposite the Grand Central Terminal, in New York City. These bus terminals were simply store space on the ground floor of the two buildings in which the railroad company maintained a small waiting room, ticket office, and parcel checking facilities. Buses were loaded and unloaded at the curb.

The new bus terminal in the Chanin Building replaces the one in the Pershing Square Building. Space for it was leased before the building was erected so that provision could be made inside the building line for bus passageways and a bus turntable. The character of the terminal is evident from the accompanying illustration.

INTERIOR OF THE BUS PASSAGEWAYS

The Chanin Building is on Lexington Ave. between 42nd St. and 41st St., opposite the Commodore Hotel, which occupies air right space over part of the Grand Central Terminal area. Underground passageways lead direct from the B. & O. terminal down into the subway station under 42nd St. and across to the Commodore Hotel and the Grand Central Terminal.

Making Engineers Effective

. . . Some Thoughts on Engineering Education

By Sidney J. Williams
Director, Public Safety Division
National Safety Council, Chicago

Our Schools teach engineering well. Do they equip the young engineer to cope effectively with the problems of practical life? Into this earnestly discussed question Mr. Williams projects a challenging line of thought. He himself has dealt with many kinds of men. He speaks from the vantage point of service as a state official followed by long and productive work in the interests of the great national safety movement. What he says is by no means a final word. "The article is deliberately provocative," he writes. It is well worth reading. —Editor.

MOST engineers admit that the world would be better managed if they and their fellows had more to say about it. They don't get over a pained surprise that so large a majority of the seats of the mighty, both governmental and other, are occupied by lawyers, business men and the like. And, with characteristic objectivity, engineering educators and alumni have not hesitated to turn the searchlight on themselves and ask what is wrong. Questionnaires have been diligently circulated and conscientiously answered; faculties have conferred with graduates. Employers have said that they wanted young men with "leadership" rather than with higher mathematics. Deans, a bit puzzled, have observed that leaders are born rather than made. Finally the Society for the Promotion of Engineering Education has undertaken its very exhaustive and most commendable investigation.

What Is Wrong . . .

Admittedly there is something wrong with engineers or with their place in the modern world. What is wrong, and why?

I submit that present-day engineering education is largely to blame; that it is one-sided and often sends the young engineer out into life with a warped perspective which may seriously handicap him in his pursuit of success and happiness. *And* that this defect of engineering education can be remedied.

Working With Facts . . .

What is the outstanding characteristic of all real engineers? Clearly it is a reverence for facts—meaning physical facts. The young engineer in college and the older engineer in practice, when they face the problem of designing a bridge, a disposal plant or an airplane, give sole thought to discovering the facts of the situation and executing the design in accordance with these facts and with the laws of physics and chemistry. If two research engineers disagree as to some fact of electronic behavior they do not engage either in public debate or in Wall Street warfare; they go back to their laboratories and seek for more facts.

As a result, the confidence of the general public in the reliability of engineering judgment *in our own field* is almost appalling. That is our strength and our glory, and no true engineer would think of permitting the slightest lowering of our high professional standard of reverence for facts.

But are there no facts except those of the physical sciences? For the young engineer in love, the "yes" or "no" of his beloved is the most important fact in the world. Later, the fact of having or not having a job, of receiving or missing promotion and an adequate income, are of vital importance to the young engineer. The supreme facts of human life thus reside in the interaction of personalities.

Surely no argument is needed to demonstrate that engineers find their most difficult problems in their relations with other men rather than in the laws of mechanics or the forces of nature. Read the lives of the great railroad builders, of the pioneers in any of the newer branches, even of the "pure" inventors. Were not their decisive successes the successes of courage, resourcefulness, diplomacy, mastery of flagging bodies and spirits?

The Personal Qualities . . .

Come down to lower levels. The young engineer does not progress very far before he encounters the need of "selling" his opinions and ideas to some one else—a non-technical employer, a prospective client, a board of directors or what not. And how often, how tragically often, has a perfectly sound idea, a perfectly competent engineer, remained "unsold" through sheer blundering awkwardness! How often has an engineer of the highest qualities seen promotion go to a rival—successful because he "knew how to get along with people"!

It will hardly be questioned that these personal qualities unrelated to chemistry and physics are vital to the happiness and success of the engineer. But what has this to do with engineering education?

As has already been intimated, many engineers make the mistake of assuming that the only facts which require attention are physical facts. That is far from true. There are biologic facts, psychological, social, economic facts. The last-mentioned are beginning to receive some attention in the training of engineers, the others hardly at all. The most important of these, from the standpoint of the present inquiry, are the facts that have to do with the influencing of human behavior.

Influencing Men . . .

There is certainly an art, and there is the beginning of a science, of influencing human behavior. The art is well understood, or at least practiced, by every lawyer, minister or physician. It is taught in schools of law and of theology—to say nothing of the "psychology of advertising" and other commercial applications. No budding Blackstone hangs out his shingle without having received instruction in the art of persuasion as well as in the science of legal analysis. Nor does he employ this art solely in moving juries to acquit the guilty; he uses it equally in effecting friendly settlements, in "engineering" a business consolidation or in achieving any sort of leadership in his community.

We engineers, generally speaking, shut our eyes to all this. The student by his very choice of an engineering course gives evidence of his fondness for the field of physical science as contrasted with human relations. In our proper ambition to develop further his knowledge of and his reverence for physical facts, we too often do him the great dis-service of stunting whatever ability he may possess in the human field. By constantly directing his

attention to the laws of nature we lead him to have less and less regard for the laws of human nature. Thus we, unwittingly of course, gradually develop in him the feeling that a thing is so if the laws of physics and chemistry say it is. Long afterward he learns, often tragically, that a bridge is not "so" until the board of directors of the railroad company says it is so.

In the Engineering College . . .

Why should not our engineering colleges impart the rudiments of the social as well as the physical sciences? I am not speaking of cultural education, and certainly I am not advocating an output of high-pressure go-getters. I am asking only that we give the young engineer, so far as we can, *all* the tools that he needs in his career.

Teach him the laws of physical motion, but teach him also the first law of human motion or action—namely, that "no appeal to a reason that is not also an appeal to a want is ever effective." Teach him to present his case not from his own point of view but from that of his listeners; to discover the unspoken reasons for the opposition of those whom he is trying to convince and to dispel the ignorance or prejudice on their part which is the real obstacle to his success. Teach him something about the underlying motives and influences that lead men to action.

This does not mean any revolutionary change in the present curriculum. It means perhaps omitting some of the more highly specialized courses — specialties in which one's real education begins after graduation in any case. It means the study of English composition, not from the standpoint of classic style but as a medium of arousing interest, conveying information and persuading to action. It means elementary instruction in public speaking from the same standpoint, which includes "public speaking" to one or two as well as to a thousand.

It means a course or two in modern applied psychology, and another in business economics. It means class projects in designing (for example) a water-supply system as a combined business and engineering problem, and then demonstrating its worth to an assumed board of directors or city council. It means studying the lives and deeds of eminent engineers and analyzing the qualities which made them great and the methods by which they achieved success. It means presenting to the young engineer the requirements and possibilities of the functional divisions of his profession—research, design, management, sales, and the rest. It means discussion of all these matters in the student societies.

And it means that those who direct this work must themselves be well-rounded men who understand both their subjects and their students.

Seattle Street Extension Provides New Traffic Outlets

Buildings Razed to Permit Extending Second Ave. 1,413 Ft. at Cost of $1,250,000—Narrow Assessment District

By W. D. Barkhuff
City Engineer, Seattle, Wash.

A TRAFFIC barrier of long standing at the southern end of Seattle's business district has recently been broken down to provide a new thoroughfare to the industrial and residential district beyond. This has been done by extending Second Ave. for 1,413 ft. through four city blocks occupied by old buildings, connecting it with the existing traffic outlet at a point between the two railroad passenger stations. The total cost of the project was about $1,250,000.

SECOND AVE. EXTENSION NEARLY COMPLETED
View from the L. C. Smith Building, shown in the foreground of the picture on the following page looking down the new extension.

The major cost item was the providing of a 90-ft. right-of-way through the type of district shown in the accompanying illustration. Acquiring this property, in-

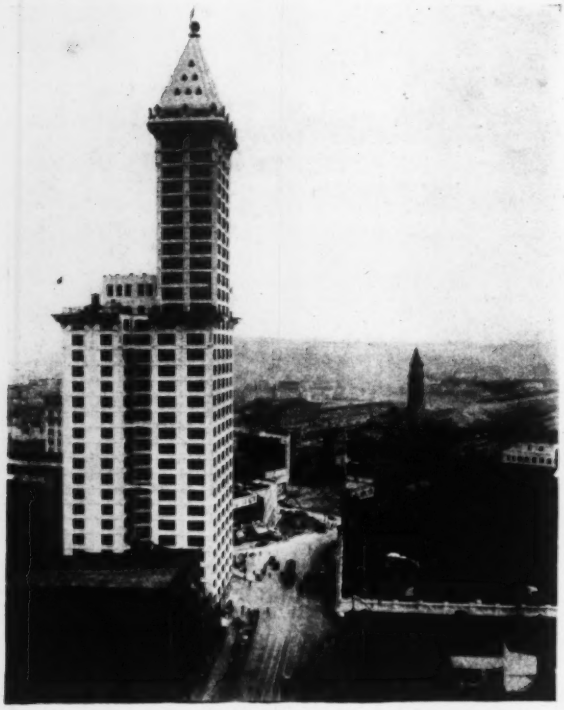
MAP SHOWING EXTENSION AND THE TWO IMPROVEMENT DISTRICTS

cluding the property damages, required expenditures of $963,663, or about 77 per cent of the total.

Construction work consisted of demolishing or altering many of the old buildings which stood on the new right-of-way, paving the street and providing a viaduct over the railway tracks. The street consists of a 54-ft. concrete pavement 9 in. thick, with an 18-ft. sidewalk on either side. New sewers, water mains and extensive reconstruction at the street intersection was also necessary. The cost of this construction work was $149,663, or about 13 per cent of the total.

This extension necessitated reconstruction work on the existing Jackson St. viaduct over the tracks of the Great Northern and Northern Pacific railways, and the construction of a new viaduct to connect Jackson St. and Fourth Ave., for a total cost of $112,300, or about 10 per cent of the total.

The accompanying map shows the extension and the limits of the local improvement districts, against which



EXTENSION OF SECOND AVE. UNDER WAY
The two railroad stations appear in the middle district.

the entire cost of the project is charged. The unusual shape of the enlarged district and the position of the improvement with respect to the assessed property bearing the cost are explained by local topography and traffic conditions. The grades of the cross-streets indicate that the lower portion of the business district of Seattle is on a hillside, rising steeply from and approximately parallel to the waters of Puget Sound. Thus any improvement affecting the traffic approach to Second Ave. constitutes practically an exclusive benefit to that street because of the very limited cross-street traffic.

The other reason, not evidenced by the map, is that a large portion of the traffic originates in the residential district in the southerly half of the city and proceeds to the business district along Fourth Ave. South. In the past this northbound traffic on reaching Jackson St. was practically forced to continue northward on Third or Fourth Ave. This was due to the traffic congestion at Jackson St. in front of the railway stations and the steep grades on the intersecting streets to the north, which practically completed the diversion of vehicles away from First and Second Aves.

The extension of Second Ave. will greatly improve traffic conditions in this part of the city and will directly benefit First and Second Ave. business property. There will be the further benefit to the entire city of having an arterial avenue extending directly to the city's two railroad passenger terminals. The Great Northern-Northern Pacific station and the Chicago, Milwaukee & St. Paul-Union Pacific stations are situated at the southerly end of and immediately adjacent to this project.

Burned Clay Cellular Aggregate for Lightweight Concrete

Weight One-Third Less Than Ordinary Concrete of Equal Strength—Uses as Structural Material

A NEW DEVELOPMENT in concrete, initiated by the construction of concrete ships during the World War, is a lightweight concrete made by using a porous hard-burned clay as aggregate. This development has been described in *Engineering News-Record* of Jan. 2 and April 24, 1919, pp. 3, 14 and 802; and Nov. 10, 1921, p. 765. With the termination of the war the shipbuilding field was closed, but the special aggregate has been used to some extent for structural concrete where light weight is desirable. In a paper presented at the annual meeting of the American Society of Agricultural Engineers, T. H. Merriam, of the Portland Cement Association summarizes the development of lightweight concrete as of the present. An abstract of his paper is given below. —EDITOR.

PRESSING need for water transport during the late war led to the construction of concrete ships. The engineers were then faced with the problem of obtaining a strong and waterproof concrete that would be as light as possible, and an effort was made to find some aggregate that combined light weight, strength and toughness. At this time Stephen J. Hayde, of Kansas City, Mo., patented an aggregate called Haydite, which was a porous clinkered substance having a highly vesicular structure, made by subjecting shale or clay to high temperatures in a rotary kiln. Eleven ships were built of this material and were successfully used until the close of the war did away with their necessity. This aggregate continued to be used for reducing the weight of structural concrete and of concrete block or tile. The past three years has witnessed rapid strides in its progress.

Kiln Process—Shale or clay, crushed to 1-in. lumps and not screened, dried or wetted, is charged into a rotary kiln about 50 ft. long and 4 ft. in diameter, sloping about 1 in 12 and revolving slowly so that the material will be kept rolling uniformly toward the discharge end. A jet of flame (from oil or pulverized coal) at the upper end brings it to about 800 deg. F., thus vitrifying a thin layer on each lump. At about 10 ft. from the discharge end the material is subjected to direct flame from two nozzles, increasing the temperature to incipient fusion at about 2,000 deg. F. The

confined combustion gases are thus able to expand because of the softened outer layer and the lumps puff out to about 2½ times their original size. The expanded material tends to fuse into clinkers, which are dropped from the kiln and allowed to cool.

Any sulphur is oxidized and thus removed. If calcium is present, it is calcined out and appears as quicklime in the aggregate. This must be hydrated by wetting the clinker to prevent any harmful effects of free lime when used in concrete, but in the absence of calcium the clinker is allowed to remain dry, as it crushes more easily. In the crushed and screened material the first grade ranges from dust to $\frac{3}{16}$ in.; the medium from $\frac{3}{16}$ to $\frac{1}{2}$ in., and the coarse from $\frac{1}{2}$ to $\frac{3}{4}$ in. The fine and medium grades are used for concrete block manufacture, while all are used in structural concrete. The different grades are shipped and stored separately until used in making concrete, in order to prevent segregation of coarse and fine particles in shipping and in storage bins. Manufacturing plants are operated at East St. Louis, Ill.; Danville, Ill.; Cleveland, Ohio; Kansas City, Mo.; Buffalo, N. Y.; and Toronto and Montreal, Canada.

Sintering Process—The sintering process of heat-treating shale for producing lightweight aggregate, patented by F. A. Glass, Chicago, is an adaptation of sintering as used in the metallurgical industry for reclaiming blast-furnace flue dust. The shale or clay is ground to ⅛-in. particles and intimately mixed with granulated coal and sufficient moisture to form a crumbly mass, which is placed in a layer about 6 in. thick on a series of moving grates. An igniting flame directed downward upon the surface of the layer starts combustion of the coal as the grates move under the flame. The burning is continued by passing the grates over a strong down draft which draws the combustion through the mass.

The grates continue to move across the draft until all combustible material is consumed. The clinkered shale is then discharged, cooled, crushed and graded into aggregate. Test on laboratory specimens of concrete made with this aggregate, which is called Lytag, indicate satisfactory performance. The inventor claims considerable economy and rapid production by sintering and is arranging for a commercial plant.

Lightweight Concrete—Monolithic concrete of a desired compressive strength can be made that will weigh approximately one-third less than when made with sand and gravel or stone. Thus, ordinary concrete having a compressive strength of 3,000 lb. at 28 days weighs 150 lb. per cubic foot, while concrete made with heat-treated clay aggregate and having the same compressive strength would weigh approximately 100 lb. per cubic foot.

In designing the mix, allowance must be made for the high moisture absorption of the aggregates, resulting from their vesicular structure. It is common practice to saturate the aggregate before mixing with cement. The figures in the accompanying table are based on tests made by recognized testing laboratories. The values for bond and shear are the same as for ordinary concrete. The modulus of elasticity ranges from 1,500,000 to 2,000,000, while that of standard concrete is from 2,000,000 to 3,000,000. The coefficient of expansion is 0.0000055, the same as for standard concrete. It will be noted that slightly larger proportions of cement are required with these aggregates to obtain concrete of the same strength as when sand and gravel are used.

LIGHTWEIGHT CONCRETE

Mix	Weight, Lb. Per Cubic Foot	Compressive Strength at 28 Days, Lb. Per Sq.In.
1:1:2	106	3,890
1:1½:3	101	2,873
1:2:2	102	2,730
1:2½:3½	100	2,465
1:2:4	98	2,345

Field procedure follows standard methods, but experience is required on the part of the operators to adjust themselves to the unusual qualities of the material. The larger pieces tend to float, and this must be considered when rather wet consistencies are employed to permit chuting. Furthermore, as in the case of other harsh aggregates, somewhat longer mixing time is desirable. The practical application of the lightweight feature is made in multiple-story structures for reducing the dead load of concrete in floors and in fireproofing structural steel, thus permitting economy in materials for columns and foundations.

WALL OF LIGHTWEIGHT CONCRETE BLOCKS

This backing of the exterior wall was channeled after erection to receive heating pipes and electric conduits.

Concrete Blocks—For precast units a rather dry mix is used, having a consistency to permit immediate removal from the mold after tamping. The cellular nature of the aggregates and the semi-plastic mix result in an extremely porous structure, which gives sound- and heat-insulating qualities and further reduces the weight. An 8x8x16-in. block of such concrete, having 40 per cent air space, weighs 26 lb. and meets the standard specifications of the American Concrete Institute for 700-lb. compressive strength per square inch of gross area at 28 days.

In 1927 the Underwriters Laboratories made fire tests on wall panels built of 8-in. hollow units, resulting in the classification of this material as a three-hour fire retardant in load-bearing or non-load-bearing walls with incombustible members framed in.

The porous concrete tends to prevent the passage of capillary moisture. The heat insulation and freedom from moisture make it practical to plaster direct to the walls. Wood trim may be nailed to the blocks, and the walls may be channeled or cut for plumbing or electrical installations, as shown by the accompanying view. This type of construction has been followed in a number of residence and apartment buildings. The delivered cost of the units in localities where they are available averages 1c. to 4c. more per block than for ordinary concrete blocks.

Final of a Series of Five Articles

Basic Principles of Concrete-Making

By F. R. McMillan
Director of Research, Portland Cement Association, Chicago

V—Importance of Proper Construction Methods

Necessity for Exact Measurement of Materials—Time Limit of Mixing—Transporting Concrete—Wrong Placing Methods to Blame for Much Unsatisfactory Concrete—Some Hints From Study of Structures in Service

Concluding an Important Series

In this closing article of the series begun in our April 11 issue Franklin R. McMillan refers in terse but instructive manner to a few of the field troubles and chances for error in concrete construction. Based on a year's effort to state the facts of the art in simplest form, his exposition is thorough; but in spite of its simplicity it calls for careful study. It will prove of greatest value if used as the basis for incisive practical reasoning by all who deal with the design, construction, or selection of the materials of concrete.—EDITOR

IT DOES not come within the scope of these articles to cover in detail all the operations incident to good concrete construction. It is, however, within their scope to set up the basic principles which should guide in the choice of construction methods and in their execution in order to assure that the concrete will be uniform throughout and of the desired quality. Such a limited treatment is all that is attempted in this, the concluding article.

Measuring Materials

The principal requirement in measuring the aggregates is that of uniformity. Not only is it important that the quality of the concrete be the same from batch to batch, but uniform consistency is equally weighty, for haphazard changes in consistency make it difficult to avoid segregation in placing. Such changes also add materially to the placing cost, since nothing so disorganizes the placing of concrete as to have the batches fluctuate from fluid to stiff, particularly where placing is difficult.

The selection of equipment for measuring aggregates will depend upon many factors, and no general recommendation can be made regarding it. The two most important considerations are the extent to which uniformity in the concrete is to be maintained and the character of the aggregates. The source of aggregate supply must receive consideration and purchase specifications should be drawn to secure the constant delivery of the kind of materials for which the plant is designed. If the aggregates vary considerably, either in grading or in moisture content, weighing equipment will prove very desirable where great uniformity is demanded. Where the aggregates come to the work with little change, either in grading or moisture content, batcher plants giving volumetric measurement can satisfy the most exacting requirement. Some of the special devices now on the market for measuring aggregates in combination with water offer certain advantages under many conditions.

In any case means for accurate measurement of the water should be provided, as this is essential for uniformity in the quality of the paste and in the consistency of the concrete. The method of measuring water should be such as will permit of the necessary adjustment to compensate for variations in moisture carried by the aggregates.

As the practice of designing mixes for definite quality comes into more general use the demand for more accurate measurement of materials will grow, for it requires only a casual contact with a job where real quality control is attempted to realize that ultimate perfection can be achieved only through mechanical means. The progress

FIG. 27—BUTTRESS OF A DAM AFTER TWENTY YEARS' EXPOSURE, SHOWING THE DISINTEGRATION DUE TO ACCUMULATION OF WATER AND LAITANCE
Note the disintegration at the top of a layer and the sound concrete at the bottom.

that has been made in the past few years sustains this prediction.

Mixing

About the only requirement of the mixing operation which is definitely recognized is that of uniformity, and even in this respect there is no exact measure of performance. Any beneficial action in the mixer other than providing a uniform distribution of materials has not been definitely established. Practically all the information available in regard to mixer performance is limited to the results of strength tests of concrete and is confined principally to the effect of variations in speed of the drum and duration of mixing. All the available tests show a rapid increase in strength with time of mixing up to a certain point, followed by a much less rapid increase for longer periods. This point of change is not the same for the various groups of tests, but has usually come within the limit of from ¾ to 2 minutes.

In view of the lack of information on the factors contributing to this increase in strength with time, it would seem a logical procedure to maintain some time limit in specifications, at least until such time as a more definite criterion of the desired performance in the mixer is found. Such data as are available indicate that for the usual concreting operations the limit should not be materially less than one minute after all the ingredients are in the mixer. In special cases it may even be desirable to increase the length of time to 1½ or 2 minutes, as watertightness is definitely increased by longer mixing and there is some evidence to indicate that increased workability may also result. These recommendations are in accord with better practice at the present time, the usual limit for ordinary concrete operations being from 1 to 1½ minutes after all the materials are in the mixer. For very large aggregates and in certain special types of work, still longer mixing times are frequently required.

FIG. 28—ANOTHER EXAMPLE OF DISINTEGRATION AT POINTS WHERE EXCESS WATER HAS ACCUMULATED IN PLACING

FIG. 29—A SECTION OF WALL 22 YEARS OLD SHOWING DISINTEGRATION AT THE BOTTOM OF A SECTION

Transporting Concrete

The method of transporting and distributing should be such as to deliver the concrete at the point of deposit in a uniform and homogeneous condition. The principal difficulty to overcome in any system is the tendency to segregation.

Under the practice of requiring a mix of fixed proportions, where changes in workability could be obtained only by changing the water content, the difficulties of segregation, both with chutes and with other methods, were greatly aggravated. Also, the quality of the concrete frequently suffered. Under the practice of designing mixes for definite quality through water control, not only can the quality be maintained but the proportions can be adjusted to give the greatest freedom from segregation no matter what system of transporting is used.

For transporting long distances, in cars, in trucks or in buggies, some separation of water from the mass can hardly be avoided even with comparatively stiff mixes. However, a general segregation of the different ingredients can be avoided by proper selection of the grading, proportions and consistency. If the placing requirements are such as to require mixes that do not transport without segregation, some means should be provided for remixing at the point of deposit.

The use of chutes for transporting concrete great distances has long been the subject of criticism on the basis of excess water and segregation. While much of this criticism has been justified owing to the poor concrete obtained, it must not be forgotten that the poor concrete was due to the manner of using the chute and is not directly chargeable to the chutes as such. It may be expected that many of the objections to the use of chutes will be withdrawn under the practice of holding to a fixed water-cement ratio. So long as assurance can be given that the mix will be delivered at the point of deposit with the required water-cement ratio and to meet the other requirements—uniformity, consistency, workability, and limiting proportions of sand—the method of transportation should be largely of only economic significance.

Vital Importance of Proper Placing

Of all the operations incident to construction, none is fraught with such consequences to the life of the structure as that of placing the concrete at the ultimate point of deposit. Too much emphasis cannot be placed upon

the need for care in this respect, for much of the unsatisfactory concrete that exists today is in some measure chargeable to wrong or careless methods of placing, combined with non-workable or segregating mixes. Even with a well-designed mixture, properly mixed and delivered in a uniform, homogeneous condition, it is necessary to exercise care in depositing so that the concrete maintains its homogeneity as it is worked into the corners and angles of the form and around the reinforcement. Any segregation or unbalancing of the mixture during this operation results in a non-uniform condition from point to point which makes certain portions of the structure more susceptible to attack by the weathering agencies.

To avoid segregation, concrete should be of a plastic consistency just stiff enough to flow sluggishly when tamped or spaded, and should be distributed in shallow, even layers, working up to the full depth as the placing progresses. Flowing over long distances in the form will invariably result in some separation of the water and fines from the rest of the mass. If the mix is too stiff or too dry it is difficult to bond successive layers and, in extreme cases, it may even develop that the successive batches may not thoroughly unite. A desirable consistency is one that results in a slight accumulation of water at the top of the layer a few feet in thickness. If the depth of the layer is considerable, this accumulation of water will increase, and as the top of the lift is approached, the consistency should be stiffened to take up the excess water in the process of placing. Small amounts of accumulated water can be drained to a low spot in the placing and be bailed or drained off. Large quantities of water, however, cannot be handled in this way because of the tendency to wash out desirable fines and cement.

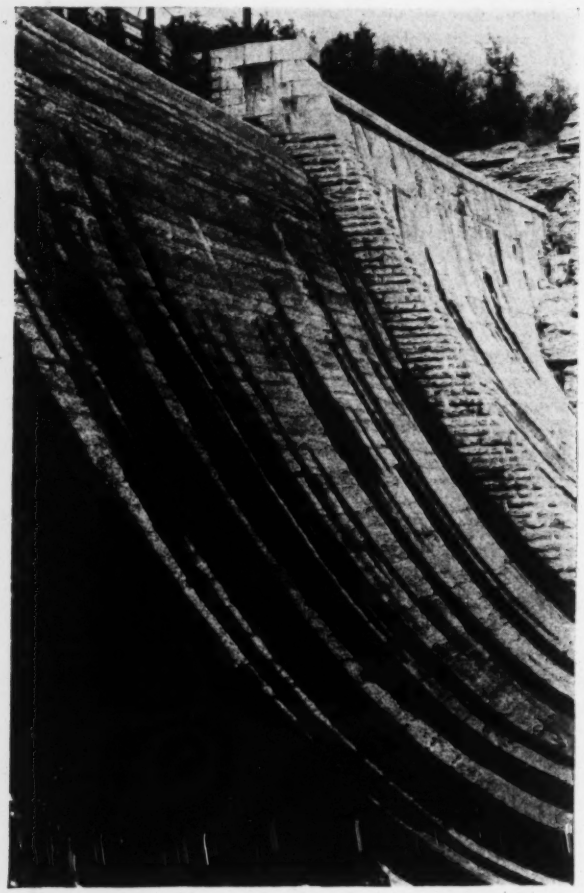


FIG. 30—AN EXAMPLE OF CAREFULLY PLACED DRY TAMPED CONCRETE AFTER 30 YEARS' EXPOSURE

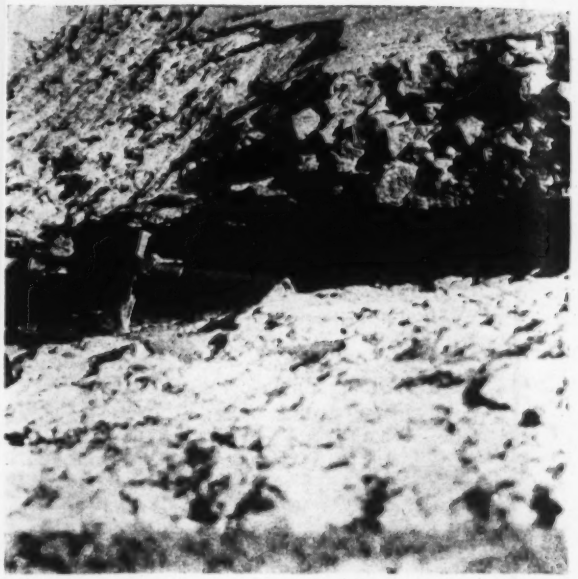


FIG. 31—AN ERODED LAITANCE SEAM IN A DAM LESS THAN SEVEN YEARS OLD

Where the placing is to stop at what will be the upper surface of the wall or section, a very good practice is to overfill the form several inches, allowing the concrete to stand in this manner until the excess water has risen to the surface and drained off. The surface can then be screeded to the proper level. This method completely avoids both the laitance layer and the porous concrete immediately below. There are a number of examples of walls finished in this manner, the tops of which have remained in excellent condition after exposure for many years to very severe conditions. The results obtained in these cases are particularly noteworthy, for the usual condition is that structures in otherwise quite satisfactory condition show serious scaling or disintegration at the top surface. Even in thin slabs such as pavements, the same water gain can be seen where the surface has been overworked in finishing, and the effects of it are evident in many scaled surfaces.

Bonding Successive Layers

An important detail in placing concrete is securing the bond between successive layers. This is of special importance where watertight structures are intended. The difficulties to be encountered can be visualized by a casual inspection of any concrete surface placed against a form where no special effort was made, by spading or otherwise, to obtain complete contact of the concrete with the form. In the case of a horizontal surface between two layers, no opportunity is presented for working the spade along the surface to provide for the complete contact between the paste of the fresh concrete and the surface of the old. The practice of flushing a grout or thin mortar over the surface before starting the fresh concrete is a very desirable one, provided the mortar is not too thin and the placing of the concrete follows immediately upon the placing of the mortar. The thickness of the mortar layer required will depend upon the stiffness of the concrete and the size of the batch. For example,

if 2-yd. buckets of very stiff concrete are being discharged on the surface, the depth of mortar coating should be an inch or more, while with concrete spread in thin layers, where an opportunity is afforded for a thorough working to insure contact, a much thinner coat should suffice. In any case, as soon as the placing is well started, so that a thoroughly bonded joint is assured, care should be taken to restore the proper consistency if the use of the mortar has made the mix too wet.

An important detail of the bonding is the character of the surface of the old concrete. This surface, of course, should be thoroughly cleaned and any laitance that may have formed should be removed. Too much emphasis cannot be placed on this matter of joints, for many structures in which the concrete has been otherwise satisfactory have developed leakage along the joints when subjected to direct water pressure.

Curing

The important part which curing plays in the building up of a solid structure to resist the entrance of water and the effect of frost has been amply stressed in the earlier articles of this series. It is necessary to point out here only that making provisions for proper curing is one of the necessary construction operations. Proper curing means not only protection from the loss of water but also the maintenance of suitable temperature conditions. The curing requirements stated at the head of Table VII are amply justified where the concrete is to be exposed to the weathering agencies. If, for any reason, such curing condition cannot be obtained, richer mixes should be used.

FIG. 32—PINE RIVER DAM, MINN.
An example of carefully placed concrete after 21 years' exposure.

Examples of Defects in Placing

A study of concrete structures which have been exposed for a number of years will show how the defects of placing are revealed by the processes of weathering. Figs. 27 and 28 are typical of many structures to be observed which are in the main serviceable after many years but which are badly scarred by the disintegration at points of weakness. Fig. 27, which shows a dam in northern United States after twenty years of service, is a good example of disintegration resulting from improper placing and a wet consistency. It is typical, also, in that the worst disintegration usually occurs in a buttress such as this. This condition results from the practice of depositing the concrete in the body of the structure and allowing it to flow toward the ends and into the buttresses, carrying the excess water and laitance with it. It can be seen that much of the structure in Fig. 27 is in satisfactory condition. However, had more care been taken to place the concrete in uniform layers with a stiffer consistency, the entire mass could have been equally well preserved. Fig. 28 is a picture of another structure in northern United States, built about 1913, which shows the same effect of the segregation due to the flowing of the concrete over long distances.

Fig. 29 shows the disintegration of the concrete just above a construction joint. The wall in this picture was constructed in 1906 and is, in general, in excellent condition. The condition illustrated is typical of what happens when very dry mixes are attempted. The first batch above a joint is likely to be honeycombed due to the difficulty of molding a stiff mix into the sharp corners. The practice of placing a batch of mortar at the beginning of a lift will generally avoid this difficulty unless altogether too harsh or too stiff mixes are being used.

Fig. 30 is an especially interesting example of a concrete structure in which a very dry, carefully tamped mix was used. This dam, which is more than 30 years old, is in a most excellent condition. It will be noted that the various layers are quite distinctly marked as a result of the scaling which has taken place at the lower edge of each layer. This shows the difficulty of getting a perfect filling of the concrete into the sharp angles where the dry tamped mixes are used. It also shows that, except for these slight imperfections, the concrete placed by these methods is durable to a high degree.

Fig. 31 is an illustration of a particularly flagrant case of segregation and overwet mixes. The large cavity which shows running through the center of this picture is an eroded laitance seam which is as much as 6 in. thick

in places and eroded back 2 ft. or more. Just above this cavity will be seen a patch of concrete in which the coarse aggregate greatly predominates, while to the left of this point is a considerable area in which almost no coarse aggregate is to be found. Just below the laitance seam also there is a deficiency in coarse aggregate. This structure is less than seven years old.

The dam in Fig. 32 is an outstanding example of the success attained by careful workmanship. This structure, which is one of the control dams built by the U. S. Engineer Corps, at the headwaters of the Mississippi River near Pine River, Minn., has stood 21 years in this severe exposure without showing any evidences of disintegration. In placing this structure a consistency was used that required some tamping but which also yielded some excess water under the tamping. This excess was soaked up from time to time as the placing progressed by working into the mortar layer an additional amount of coarse aggregate. The excellence of this structure will be apparent from a close study of the illustration. It is a wonderful tribute to intelligent and careful supervision.

Concluding Remarks

In this series of articles there has been presented a philosophy of concrete mixtures, amply supported by experimental data and construction experience, upon which can be based the production of concrete to meet specific requirements of strength and durability. Necessary details for applying the principles developed and precautions for handling and placing the concrete have been given. However, one further requirement remains. There must be a recognition on the part of someone in authority that uniform concrete of good quality requires intelligent effort and faithfulness to details all along the line—proper materials, proper design, proper mixing and transporting, and special care in placing and protecting. It must be recognized that to obtain the desired results some qualified person must be made responsible for these details, and having been made responsible, must be intrusted with the necessary authority.

Too often individuals in ultimate authority have the desire for concrete of the proper quality, but fall short of attaining it through failure to delegate the necessary authority and to fix the responsibility for results. It is not uncommon to find a construction superintendent in a position to ignore the recommendations of the engineer where, in his opinion, they impede the progress of the work or increase the cost. If, under such conditions, quality is subordinated to first cost, durable structures cannot be expected.

It must not be assumed that because it requires well-directed effort to produce uniformly good concrete the cost is necessarily increased. There have been any number of examples in recent years where rigid control of the concreting operations not only has given concrete of the required quality but has shown a distinct saving in *first cost* as compared with earlier experiences in which only indifferent or unsatisfactory results were obtained. But even if the first cost is increased by the requirements for definite quality, the ultimate cost which must include maintenance and repair charges will be greatly decreased. In support of this statement, if support is needed, a number of examples can be cited where the expenditures for maintenance and replacements have been many times the amount which would have been necessary to insure the highest quality of concrete at the time of original construction.

A comparison of Figs. 31 and 32 gives a good illustration of the investment value of good concreting methods. Fig. 31 shows a structure but a few years old that is already in need of major repairs and may shortly require almost complete rebuilding. In this structure almost every requirement for good concrete seems to have been violated. Fig. 32, on the other hand, shows a structure in which care was taken in all the operations. It is still in perfect condition after 21 years in an exposure more severe than that to which the structure of Fig. 31 is subjected. It needs only the the briefest consideration of such a contrast as that presented by these two structures to realize how immensely productive in increased life and reduced maintenance charges a few extra dollars can be, when spent to secure suitable mixtures and careful placing.

Method of Forecasting Seasonal Streamflow

California-Oregon Power Company Predicts Low Flow by Comparing Rainy Season to Past Rainfall-Runoff Ratio

By John F. Partridge

Formerly Assistant Engineer, California-Oregon Company

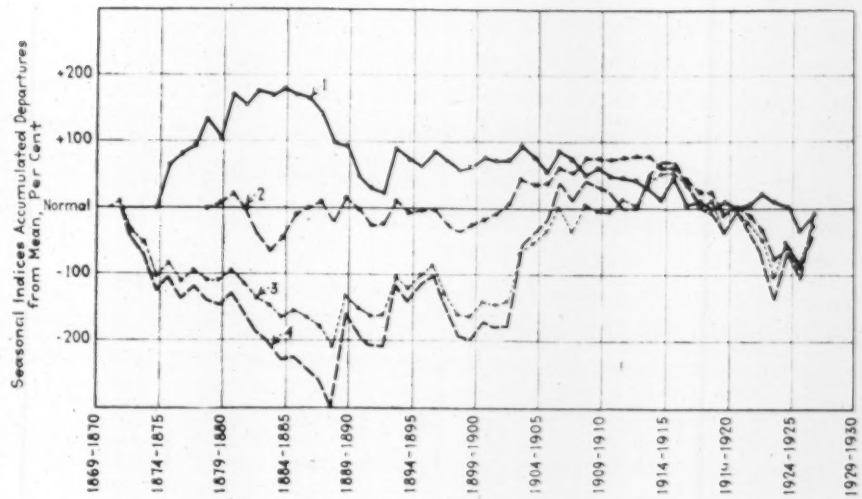
PREDICTING annual runoff by comparing the precipitation for the current season with the relation between past rainfall records and the corresponding runoff has been a part of the operating routine of the California-Oregon Power Company for the past five years. Monthly precipitation records during the rainy season are reduced to percentages of the normal rainfall and plotted as a cumulative mass curve. The tendency of this curve to exceed or fall below the normal curve is the basis for a qualitative forecast of the flow runoff for the next summer and fall in terms of percentage of normal.

Situated in southern Oregon, the system of this company comprises both streamflow and storage plants located on the Upper Klamath River. Proper regulation in releasing water from storage reservoirs to equalize correctly the low flow period prompted the company to study the possibility of runoff prediction. The success of early attempts was sufficient to secure the co-operation of the United States Bureau of Reclamation in connection with the Klamath irrigation project.

The territory of the Upper Klamath River covers about 3,500 square miles on the east slope of the Cascade Range, comprising a district of volcanic origin. The watershed is capable of absorbing most of the precipitation, and this natural reservoir maintains a marked regularity in streamflow. Below the headwaters at El. 4,100 Upper Klamath Lake forms a natural regulating reservoir, which has been augmented by a dam to secure full regulation.

Precipitation records for the Klamath basin begin in 1884 and for a number of years the rainfall record at Klamath Falls was used as a basis for all water-supply studies. This record is erratic in seasonal distribution and is inconsistent with the runoff records for the watershed. A second station situated in territory more typical of the basin, although only 40 miles distant from the first, was found to give a rainfall record with variations that more nearly parallel the variations in the runoff record and is now used.

The runoff record was established in 1904 and is measured at the inflow to Klamath Lake. Inflow is determined from the measured outflow and the recorded rise and fall of the water surface, thus compensating for evaporation. Snow surveys over the watershed have been undertaken only recently. Temperature and evaporation records are used as an aid in establishing the probable distribution of expected runoff. Observations of plant life, movement of animal life, general business conditions and the probable irrigation demand for the coming season are also used in interpreting the more positive data.



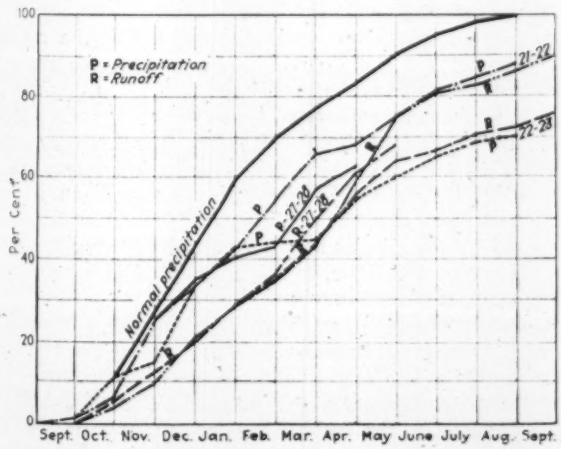
TREND OF WETNESS FOR WESTERN OREGON AS SHOWN BY RAINFALL AND RUNOFF RECORDS

(1) Rainfall at the Dalles, Ore. (3) Averaged rainfall, Klamath, Trinity Basin.
(2) Averaged rainfall, Upper Rouge Basin. (4) Runoff, Klamath, Trinity Basin.

Forecasting of the streamflow is based on the relationship between runoff and precipitation, established as accurately as possible from the available records. Over a representative period of years this ratio will show normal runoff corresponding to normal rainfall and variations both above and below normal tending to form a curve demonstrating this relationship.

Preparation of the data follows the method of C. E. Grunsky in his rainfall and runoff studies for California (*Transactions* Am.Soc.C.E., Vol. 85, 1922, p. 66). Monthly precipitation in inches and runoff in acre-feet are converted to a percentage of the normal annual total to give a common denominator for making comparisons easier.

The seasonal accumulation of rainfall and runoff is plotted by months on a mass curve as shown by the accompanying drawing. Rainfall records are started on Sept. 1 and runoff records on Oct. 1 of each year, giving an arbitrary allowance of one month for the lag of the runoff behind rainfall. These curves for a normal year would show a total of 100 per cent at the end of the season. For other years the variation above or below normal will show the "index of wetness" and "index of runoff" for the current year. Interpretation of these indices by referring to the established rainfall to runoff ratio curve is the basis of a forecast for the coming low flow season, modified if necessary by other factors already mentioned.



RAINFALL AND RUNOFF CURVES ACCUMULATED BY MONTHS COMPARED WITH NORMAL RAINFALL

In addition to data for the current year these records when extended for a period of years show the "trend of wetness," which is the variation of the total annual precipitation from the normal established by the length of the records in the region. The trend of wetness in southern Oregon and northern California for the last ten years has been so consistently downward as to be somewhat disconcerting at this time, as shown on the accompanying curve. Perhaps the critical point was reached in 1923-24 or 1925-26 and the trend will again be upward. On the other hand, perhaps the minimum is still to be reached; only time can give the correct interpretation.

The foregoing method of predicting probable low flow depends on the extent of the past records available for the territory and the completeness of the interpretation. A general knowledge of the topography and geology of the drainage basin is fundamental. The rainfall station should be selected for the similarity between its variation from normal and the variation of the runoff records from normal. The runoff records should be obtained from a station close to the point of use and will depend on the records which are available. Snow records give a qualitative factor based on a record showing depth and density of unmelted snow remaining on the ground at fixed stakes or the average depth and density over fixed courses. Of the two methods, the latter is preferable, though excellent comparative results have been effected through the former cheaper means. As snow surveys become more extensive and the records grow longer their value will increase.

Observations of general conditions are valuable in supplementing the more positive data. Prompt monthly reports on all the data being used is essential.

South American Railway Congress

The Third South American Railway Congress will be held at Santiago, Chile, in December, 1929. At the same time it is planned to have an exhibition of railway materials and roadbuilding equipment.

Municipal Airport Established at Pontiac, Mich.

Topographic and Soil Conditions Governed Site Selection—Grading, Buildings and Lighting—Ordinances

By G. D. Kennedy

Civil Engineer, Department of Water Supply, Pontiac, Mich.

FOR THE construction of a municipal airport the people of Pontiac, Mich., provided $180,000 as a part of a $2,000,000 improvement program adopted May 8, 1928, by a four to one vote. A site was purchased on Sept. 12 and the port was opened Nov. 27 with the inauguration of air mail. In the selection of the site, the rapid building of the port and its subsequent operation there were several novel applications of engineering methods.

Selection of Site—Of numerous parcels of land offered for sale only eleven were considered worthy of careful examination and study. Many others were readily eliminated because of rough topography, which prevails quite generally in the glacial morainic terrain about Pontiac. The only possible sites occurred on outwash plains, and one or two of these stood out preeminently even in preliminary examination. An A1A field, so rated by the U. S. Department of Commerce, was determined upon as the standard to be met.

After careful study, site No. 8 was chosen as possessing the most advantages, including comparatively low cost. The chief factors affecting this decision are of interest. The site is at the geographical center of Oakland County and lies almost on the direct line of air travel between the Ford airport at Detroit and the cities of Flint, Saginaw and Bay City. Prevailing winds are from the west and southwest, and at an industrial city where much smoke is emitted it is important that an airport be on the side from which prevailing winds blow. This site is located ideally for rapid transit to and from Pontiac, as the downtown area and commercial district can be reached by three paved routes without a railroad grade crossing or other obstacles to travel. The distance is about 7 miles, or about fourteen minutes' time under average traffic conditions.

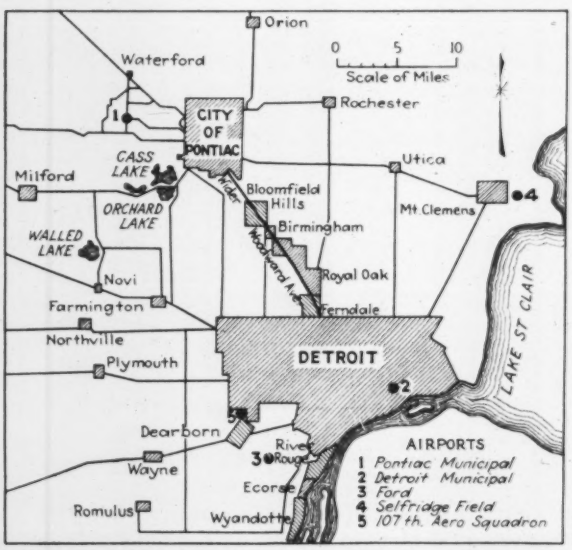


FIG. 1—PONTIAC AND NEIGHBORING AIRPORTS

FIG. 2—AIRPORT HANGAR AND BEACON AT PONTIAC, MICH.

Aside from its location, this site possessed the most advantages for low-cost development. It was fairly flat, except for a few knolls and depressions, having not more than 4 ft. difference in elevation between the mean elevation of any of the four corners. There was available for immediate purchase a quarter-section, or 160 acres, while 80 acres adjacent, of similar topography, made a rectangular tract 2,640x3,960 ft. Existing buildings, fences and trees offered no unusual problems.

But the soil was the deciding factor. The top soil consisted of sand mixed with a small amount of clay. The under-soil of 2½ or 3 ft. depth consisted of coarse sand and small gravel. This unusual combination permitted rapid natural surface drainage and at the same time presented a surface which, while appearing somewhat fluffy, actually compacted very well when dry even under the cutting pressure of heavily loaded truck tires. The initial purchase was 160 acres for $103,500, or about $650 per acre, which is in keeping with prevailing prices in this area. Condemnation proceedings were instituted later for the additional 80 acres. Having acquired the site, it was necessary that it be developed at the earliest possible date, so that the city could secure the advantages of air mail and aviation.

Comparison of Airport Sites—An interesting comparison of the relative suitability values of these eleven sites, given in the accompanying table, is based on the analysis suggested by P. A. Fellows, city engineer of Detroit, in his article on the engineering aspects of airports, in *Engineering News-Record*, Sept. 6, 1928, p. 340.

Construction of the Port—The first step was a preci-

topographical survey of the 240 acres, using a contour interval of 1 ft. and a scale of 1 in. to 200 ft. A comprehensive plan of development was then prepared. This included locations for present and future hangars, administration buildings, restaurant and hotel facilities, and a complete illumination plan for night flying. It was early decided that permanent buildings should be constructed and that all construction should be required to conform to comprehensive plans of arrangement and architecture. The highway master plan for Oakland County provided for future 120-ft. roadways along the south and east sides of the property, and the necessary strips were set aside along the present 66-ft. roads for this future development. The airport site, together with the plan of development, is shown in Fig. 3.

The clearing of the property was begun immediately, all fences, trees and buildings being removed. A permanent steel fence was erected along the roadway sides, and overhead wires were removed from the airport side of the highways. From an extensive study of cross-sections of the property, a definite plan of grading was determined upon and bids were received for furnishing grading equipment. Seven outfits were employed at the rate of $2.25 per hour each, which included a tractor, an automatic fresno scraper or other grading device, an operator and the necessary fuel.

As numerous fence rows and furrows marred the surface, it was first necessary to plow the entire field. Graders were then used to remove the tops of small knolls and fill slight depressions, so that there were no areas where the grade was in excess of 1 per cent. One large depression in the center of the field, protected temporarily by obstacle lights, will be filled in the spring, requiring about 10,000 cu.yd. The field was then rolled with ordinary farm-type rollers for the purpose of compacting the soil, after which a specially designed scraper removed slight irregularities and further compacted the surface. The final operation was to surface the entire field with a heavy float built up of planks.

Rain fell at frequent intervals during the grading operations and aided in the compacting of the ground. The final result was a compacted crustlike surface which is very firm and yet allows water to pass through it readily. Freezing weather followed almost immediately upon the completion of these operations and the field passed into the winter months with an almost perfect surface.

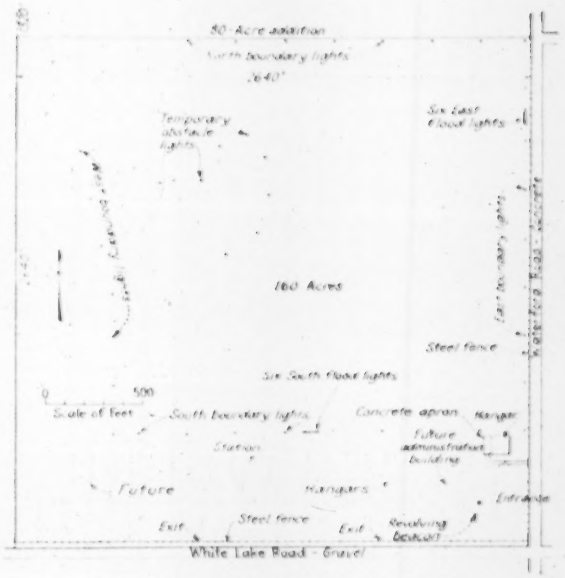


FIG. 3—PLAN OF MUNICIPAL AIRPORT AT PONTIAC, MICH.

Analyses of soil samples have been made by the U. S. Department of Agriculture and the Michigan State College of Agriculture, and a program of soil development is to be carried out. While quack grass would best produce the desired turf, it is unlawful to sell this seed in Michigan; therefore other grasses resistant to soil acidity will be used, such as mixture of red-top timothy, fescue and Canada blue grass.

Hangar—Bids were received for the construction of a brick and steel hangar 100x100 ft., with a 20-ft. vertical clearance between the floor and roof trusses and a 12-ft. lean-to for office and shop space along one entire side of the building. This contract was let to the Austin Company, Cleveland, Ohio. Large steel doors fitted with steel sash and operated on roller-bearing wheels permit of the complete opening of one end of the building. Intense interior illumination is supplied at 0.6 watt per

COMPARISON OF SITES FOR PONTIAC AIRPORT

Items of Operation	Relative Unit Value	Proposed Sites (Nos. 1–6)						Adopted Sites (Nos. 7–11)				
		1	2	3	4	5	6	7	8	9	10	11
Freedom from dense river fogs	8	8	8	8	8	7	7	7	8	6	7	7
Freedom from ground mist	5	4	5	5	5	7	7	7	8	6	7	7
Freedom from smoke conditions	6	1	2	2	5	5	6	6	6	6	6	6
Freedom from snowdrifts	1	1	1	1	1	1	1	1	1	1	1	1
Freedom from air travel interference	4	2	4	4	2	2	4	4	4	4	4	4
Prospective neighborhood development	2	1	1	1	1	1	2	2	2	1	2	2
Area of field	8	2	4	5	4	7	5	5	8	7	7	8
Configuration of field	4	2	3	3	2	2	2	2	4	1	2	2
Freedom from objectionable air currents and eddies	1	1	1	1	1	1	1	1	1	1	1	1
Approaches—satisfactory areas under takeoffs	3	0	1	1	1	1	2	2	3	0	2	2
Favorable prevailing winds with reference to runways	4	1	2	2	2	2	4	3	4	1	2	2
Other factors affecting safety	4	1	3	3	1	1	3	3	4	3	4	4
Total units	50	24	35	36	33	34	41	40	50	35	43	44
Items of Location Value												
Location with respect to the axis of air travel	8	5	4	4	6	6	7	7	8	6	6	6
Distance and direction from the source of air travel business	7	6	3	3	5	5	4	4	4	4	3	3
Distance from the geographical center	4	4	2	2	4	4	3	3	3	3	2	2
Distance from center of population	8	7	4	4	6	6	5	5	5	5	4	4
Distance from rail terminals	2	2	1	1	1	1	1	1	1	1	1	1
Distance from water terminals	1	1	1	1	1	1	1	1	1	1	1	1
Distance from post office	6	6	4	4	6	6	5	5	5	5	4	4
Distance from hotel center	5	5	3	3	5	5	4	4	4	4	3	3
Distance from economic center	3	3	1	1	3	3	2	2	2	2	1	1
Distance from financial center	3	3	3	3	3	3	3	3	3	3	3	3
Distance from center of airplane manufacturing industries	3	3	2	2	3	3	3	3	3	2	2	2
Total units	50	44	28	28	42	43	34	38	39	36	30	30
Total suitability units	100	68	63	64	75	78	79	78	89	71	73	74

square foot of floor area for the hangar that has been initially provided.

Field Illumination—Electrical energy is brought from two directions by means of 4,800-volt overhead power transmission lines, to safeguard the supply in case of failure to either line. In underground duct it is carried across the property to the transformers and main switchboard in the hangar lean-to. The energy is stepped down to 480, 240 and 120 volts for varied uses. A remote-control switch panel in the main office, operating contactors on the main switchboard, is the first of its type. Its centrally operated fingertip control is a far step from the commonly used massive switches scattered about an airport. Ten circuits operate from the panel, each equipped with a toggle switch and a red and green bullseye indicating lamp. The green light indicates the circuit is in working order and the red that the switch is closed and the circuit is "hot."

Night flying facilities are provided to meet the regulations of the U. S. Department of Commerce. A revolving beacon on a 50-ft. steel tower is equipped with two alternate 900-watt, 32-volt lamps. Two banks of field floodlights, six units each, mounted 9 ft. above the ground, are equipped with 3,000-watt, 32-volt lamps. Boundary lights at 250-ft. spacing surround the field. These units, equipped with 60-watt, 250-volt lamps, are 5 ft. above ground. Other equipment includes a 500-watt ceiling projector, wind cone illumination and complete exterior hangar illumination consisting of apron floodlights, roof flood and obstacle lights, and exterior wall lights. Identification markings as required by the U. S. Department of Commerce consist of a circle marker, wind cone, name of city and complete illumination facilities.

FIG. 4—FLOODLIGHTS AND BOUNDARY LIGHTS
Group of six floodlights 9 ft. above ground. At the ends are two of the boundary lights, 5 ft. above ground.

Cost—The total cost was $170,607, distributed as follows: Sale of bonds, $235; purchase of land, $103,500; paving taxes, $4,070; topographical survey, $388; clearing, $2,852; drainage, $435; grading, $4,688; fence, $4,179; hangar, $30,240; lighting, $14,863; water supply and fire protection, $3,150; gasoline and oil supply, $731; landing facilities, $22; signs and photographs, $140; engineering and inspection, $1,114. The fact that the funds were provided through municipal bond issue rather than through the generosity of citizens seemed to help in the unhampered carrying on of the construction work.

Operation of the Airport—To assist in drafting a municipal ordinance pertaining to aeronautics and the operation of the airport, information as to ordinances was obtained from the most important ports throughout the country. Guided by this information, the U. S. air commerce act of 1926 and the air commerce rules promulgated thereunder, an ordinance was prepared having local conditions particularly in mind. Field rules and fees to be charged are provided by resolution of the city commission under authority of the ordinance, so that they may be more flexible and changed readily as conditions necessitate.

It is the ultimate aim of the airport that it may be financially self-sustaining. To help in attaining this end there are many possible sources of revenue, as follows: (1) Profit from sale of gasoline and oil, (2) rental of hangar space, (3) a percentage of the gross revenue of commercial operators, (4) dead storage for airplanes, (5) airmail and express contractors, (6) leases of hangar space, (7) concessions. The airport revenue for December was approximately $300. This is not an imposing sum, but seems satisfactory and promising when it is considered it was the first month of operation and an unseasonable time of year for starting this sort of enterprise and that there had been no solicitation or port advertising. Five airplanes are now kept in the hangar and this number will be increased shortly. The city employs a day operator, a day caretaker and a night operator.

C. W. Ham, city manager, approved the policies adopted and was the guiding spirit in developing the aviation facilities which look far into the future. The night flying and illumination equipment was installed under the supervision of H. J. Morton, city electrical superintendent. The writer was charged with the immediate responsibility for the selection of site, construction and operation of the port.

Displaced Aggregate Decreases Joint Thickness

Recent observations of contraction joints in some 300 miles of concrete pavement in Maricopa County, Arizona, were supplemented by cores taken to show typical sections at the joints. The cores showed that aggregate had penetrated into the filler, probably in tamping and in other finishing operations to an extent that often decreased the effective thickness of the joint by one-half. Work on the first of two Maricopa County paving contracts that totaled more than $8,000,000 was described in *Engineering News-Record*, June 16, 1921, p. 1026. On this job contraction joints were made 1½ in. wide which, county officials now believe, is barely enough. In hot weather climates 2-in. widths are suggested as preferable due to the danger that the effective thickness is likely to be so materially decreased by displaced aggregate.

Lost-Time History of a Concrete Road Job

Hourly and Percentage Analysis of Production Record—Itemized Mixer Delays Due to Gravel Plant Hauling, Water Supply, Grading, Finishing Machine, Mixer Holdups and Weather—Job Management Chiefly Responsible for Time Lost

By D. V. Purinton
Austin, Tex.
Formerly Engineer in Charge of the Work Described

Lost Time continues to be a heavy charge against road construction. Analyses made by the Bureau of Public Roads indicate that delays are confined to no particular type of road or kind of roadbuilding operation. Means of reform therefore have wide interest. The following article is an unusually detailed presentation of the lost-time record of a concrete roadbuilding operation in a Northern state. It represents conditions none too good for full utilization of time, which were aggravated into large time losses by errors of management. It shows the counting up of small delays which constitute a great time loss. It exhibits the multitude of ways in which delays happen. With the exception of a concluding summary kept very brief, the author has made his article purely objective. It is a detailed count and narrative of roadbuilding delays and not a preachment on evils and lapses in contracting management. Herein lies its claim for respect. —Editor.

THE original project consisted of 4.4 miles of 6-9-6-in. 1:2:4 concrete pavement and all grading, drainage structures and shouldering; it was increased by 2.2 miles after work had been started. This study covers the operations on the entire 6.6 miles. The contract was let April 19, 1927, and the contractor agreed to start work not later than May 1, 1927, and to complete the road on or before Dec. 1. A railroad with available sidings at both ends paralleled the project, but the contractor exercised the option of using local materials and set up his plant at a pit about 2 miles from station 250 of the job.

Construction Plant—The contractor's equipment was divided into three groups—gravel plant equipment, grading equipment and paving equipment—and consisted of the accompanying summary of construction plant.

Description of Work—The road contained no grades greater than 3 per cent. Most of it was nearly flat and on an old gravel road which had to be scarified and adjusted to the 1-in. crown of the new subgrade.

The soil was a clay loam with a few stretches of gravel near one end. The grading was very light, about 85 cu.yd. per station, and was nearly all ditch excavation.

SUMMARY OF CONSTRUCTION PLANT

Gravel Plant:
- 1 18-in. jaw crusher.
- 1 25-hp. diesel engine.
- 2 Revolving screens with circular openings from ¾ in. to 1¼ in.
- 1 Ford tractor for running screens.
- 1 Washing plant complete with conveyors and pump.
- 1 Wooden hopper with batchmeters.
- 1 Crane with clamshell bucket.
- 1 Dragline complete with steam engine.

Supplementary equipment added after the project was started:
- 1 25-hp. diesel engine.
- 1 20-in. jaw crusher (abandoned).
- 1 36-in. jaw crusher (new).

Grading Equipment:
- 1 Case tractor (rented).
- 1 Heavy blade grader.
- 1 10-ton tractor.
- 1 Light grader on Fordson with caterpillar drive.
- 6 No. 2 wheelers.
- 4 Drag scrapers.
- 1 Gas shovel ½-cu.yd. capacity.
- 4 2-ton dump trucks.

Paving Equipment:
- 1 Subgrader.
- 1 Five-bag paver.
- 1 Finisher.
- 1 Triplex road pump.
- 1 Steam road pump.
- 20,000 lin.ft. 2-in. water pipe.
- 8 Dual pneumatic three-batch trucks (subcontractor).
- 4 Hard rubber-tired three-batch trucks (subcontractor).

TABLE I—SUMMARY PRODUCTION RECORD

Week	Total Day Hr.	Min.	Total Lost Time Hr.	Min.	Avoidable Lost Time Hr.	Min.	Unavoidable Lost Time Hr.	Min.	Mixer Hours Hr.	Min.	Linear Feet Laid	Sq.Yd.
1	40	00	18	00	4	15	13	45	22	00	941.0	1,882.0
2	60	00	32	20	31	30	0	50	27	40	1,654.2	3,382.0
3	63	00	22	50	22	05	0	45	40	10	2,469.6	4,983.8
4	63	00	9	30	9	30			53	30	3,704.8	7,409.6
5	63	00	37	20	26	50	10	30	25	40	1,241.6	2,483.2
6	63	00	28	50	15	55	12	55	34	10	2,409.1	4,818.2
7	63	00	17	00	5	05	11	55	46	00	3,204.3	6,408.6
8	66	00	58	00			58	00	8	00	327.2	654.4
9	66	00	12	55	12	30	0	25	53	05	3,923.3	7,846.6
10	66	00	25	05	24	05	1	00	40	55	3,172.2	6,344.4
11	66	00	64	05	3	25	60	40	1	55	193.0	386.0
12	66	00	49	15	3	55	45	20	16	45	1,172.0	2,344.0
13	71	10	28	10	9	55	18	15	43	00	3,190.6	6,381.2
14	67	00	15	48	14	33	1	15	51	12	3,641.0	7,282.0
15	60	00	60	00	50	00	10	00				
16	40	00	32	00			32	00	8	00	473.0	946.0
17	30	00	19	15	6	35	12	40	10	45	828.1	1,656.2
18	56	00	22	20	15	00	7	20	33	40	2,451.2	4,902.4
Total	1,069	10	552	43	255	08	297	35	516	27	34,996.2	70,110.6

103 days total; 72 days worked paver; 20 whole days rain, 41 days some rain delay; 339.7 ft. average per day, and 486 ft. average per day worked.

Project History—The work of setting up the gravel plant was begun about June 9, 1927. The first culvert excavation was begun on June 13 and after three days of rain the culvert was completed and ready for backfill on June 25. By July 11 the third and last culvert on the original project was completed and the two remaining culverts and one 40-ft. span bridge were left to be completed at a later date.

The first grading began at station 0 on June 30, with the crew working on the plan of moving only the dirt necessary for the construction of the concrete slab and leaving the remainder of the earthwork to be completed after the slab was laid.

The first road forms were set on July 14 and on this day the contractor came to the conclusion that his 18-in. jaw crusher at the gravel plant was too small to produce the necessary output of 1½-in. stone required for the job. To remedy this he purchased a second-hand 20-in. jaw crusher and motor and began their installation.

The truck fleet arrived on July 19 and on the same day the crankshaft of the pump motor at the gravel pit was broken; another second-hand motor was installed to replace it.

Paving was started on July 20 with only half of the expected truck fleet on the job and as a result the progress of the mixer was rather slow. In three days, however, the output of the gravel plant was used up and for the next three weeks there was a continuous delay waiting for material. On Aug. 11 the gravel plant was put on a double-shift operation until the arrival and installation of a new 36-in. jaw crusher would relieve the situation.

Mechanical trouble with the mixer due to negligence on the part of the operator and foreman cost several days during the middle of August, and on Aug. 24 the paving foreman was discharged for drunkenness on the job. The crew worked without a foreman until Aug. 29, when both a new foreman and a new mixer operator reported for work.

Considerable difficulty was encountered with the small $\frac{3}{8}$-in. plugs used for sprinkling attachments on the water line when the pressure was increased to take care of $3\frac{1}{2}$ miles of line.

The majority of the weather delays came during September and October, when there were five and six consecutive days of rain that left the clay subgrade in an almost impassable condition.

On Sept. 22 the connecting-rod bearings of the mixer burned out as a result of the lack of mechanical attention during the earlier part of the season. An attempt to patch them up failed and it was necessary to install a new motor for the remainder of the job. After the repairs were completed only one day of paving was possible before a siege of rain and sleet storms that practically paralyzed all construction work in that section of the country.

When the rain let up the grade was a sea of mud on which it was impossible to pave, and foggy and damp days failed to improve the condition. To get started again, the trucking contractor made a special price on hauling sand, and the wet clay was shoveled out of the forms and replaced with sand from the pit.

The majority of the original crew had disappeared during the rainy spell and the start was made with a makeshift crew that was gradually replaced by railroad men filling in between calls. They made the best organization of the entire season and had not the weather been against them would have completed the best operation record of the job.

Lack of grading equipment and lack of effort to secure such at the proper time resulted in a week's delay in making the fill at the bridge approaches, with the result that snow and frost caught the contractor with about 3,200 ft. left to pave the following spring.

This remaining stretch was completed during the week ended May 26, 1928, and the paving equipment was moved off the job the following week. The shouldering and finishing crew remained until July 30, 1928, when the last mile was seeded and completed ready for final inspection.

Grading—In the plan of getting the slab laid regardless of the earthwork to be done, the contractor followed the general practice by which grading and paving are let as a part of the same contract. As a result nearly 65 per cent of the earth excavation was left until after the pavement was laid and opened to traffic and in this

TABLE II—ANALYSIS OF PRODUCTION ON HOURLY BASIS

Date	Total Batches	Batches Per Mixer Hour	Batches Per Available Working Hour	Total Linear Feet	Feet Per Mixer Hour	Feet Per Available Working Hour
Week 1	430	19.5	16.3	941	42.7	35.8
Week 2	786	28.4	13.2	1,654.2	59.8	27.9
Week 3	1,139	28.3	18.3	2,469.6	61.6	39.7
Week 4	1,733	32.4	27.6	3,704.8	69.3	58.8
Week 5	588	22.8	11.2	1,241.6	48.4	23.7
Week 6	1,123	32.7	22.4	2,409.1	70.5	48.3
Week 7	1,485	32.3	29.0	3,204.3	69.7	62.7
Week 8	159	19.9	19.9	327.2	40.9	40.9
Week 9	1,832	34.6	28.0	3,923.3	74.0	59.9
Week 10	1,443	35.3	22.2	3,172.2	77.5	48.8
Week 11	87	45.6	16.3	193.0	100.5	36.2
Week 12	559	33.4	27.0	1,172.0	70.2	56.7
Week 13	1,512	35.2	28.6	3,190.6	74.0	60.2
Week 14	1,691	33.1	25.7	3,641.0	71.3	55.5
Week 15	221	27.6	27.6	473.0	59.0	59.0
Week 16	391	36.3	19.7	828.1	77.0	44.6
Week 17	1,162	34.6	23.8	2,451.2	73.0	50.5
Jon	16,341	31.7	21.2	34,996.2	67.8	45.4

TABLE III—PERCENTAGE OF DAYS LOST BY VARIOUS PARTS OF ORGANIZATION

Mixer	4.94	Trucks	2.94
Tamper	0.82	Miscellaneous	2.17
Grade	7.76	Weather	24.94
Plant	4.58		
Crew	0.00	Total	51.61
Water	2.86		

TABLE IV—DESCRIPTION OF DAILY TIME LOSSES OF MIXER

Date		Amount Hr.	Amount Min.
July			
22	Skip clutch slipping	1	15
23	Dirt in carburetor	0	30
	Leaky hose connection—engineer's shutdown	1	00
Aug.			
19	Operator sick. No substitute	1	30
	Motor valves sticking	3	40
20	Overhauling motor	10	30
23	Main drive gear stripped	7	30
	Adjusting valves	2	00
31	Overheated motor, cooling tank not filled	0	35
Sept.			
2	Caterpillar drive chain broken	0	30
12	Skip cable broken	1	25
	Cement in carburetor	1	00
19	Cement in carburetor	1	20
20	Loose bolt in skip axle	0	20
22	Caterpillar drive chain broken	0	10
	Motor bearing burned out	3	30
*23	Motor bearing burned out	2	25
24	Installing new motor	11	00
26	Broken radiator hose	0	20
	Loose bolt in skip axle	0	25
	Skip cable off reel	0	10
Oct.			
14	Ice in carburetor	0	10
18	Caterpillar drive chain broken	0	10
19	Replacing clutch disk	1	18
20	Loose pin in mixer discharge	0	10
22	Loose clutch	0	20
	Total	52	53

TABLE V—DESCRIPTION OF LOSSES BY FINISHING MACHINE WHICH DELAYED PAVER

Date		Amount Hr.	Amount Min.	Date		Amount Hr.	Amount Min.
July				Oct.			
22	Magneto trouble	0	45	5	Ignition trouble	0	50
26	Out of gas	0	20	8	Broken tamper spring	0	30
26	Magneto trouble	1	10	13	Run off forms	0	20
Aug.				20	Ignition trouble	0	25
9	Magneto trouble	1	00	21	Broken gas line	0	20
10	Magneto trouble	1	30	May			
27	Valves sticking	0	25	18	Valve sticking	0	10
Oct.				26	Broken gas line	0	10
4	Ignition trouble	0	25		Total	8	50

TABLE VI—DESCRIPTION OF LOSSES AT GRAVEL PLANT THAT DELAYED MIXER

Date		Amount Hr.	Amount Min.	Date		Amount Hr.	Amount Min.
July				Aug.			
25	Rock crusher too small	10	00	9	Crusher too small	1	30
26	Rock crusher too small	1	30	10	Crusher too small	0	30
27	Rock crusher too small	1	40	11	Crusher too small	1	00
28	Rock crusher too small	1	50	24	Broken brake on crane	1	30
29	Broken crankshaft	5	00	Sept.			
30	pump motor	10	00	22	Crane magneto trouble	0	25
Aug.				Oct.			
1	Crusher too small	5	20	21	Crane cable broken	0	15
3	Crusher too small	2	30				
4	Crusher too small	5	00		Total	49	00
8	Crusher too small	1	00				

TABLE VII—MIXER TIME LOST DUE TO TRUCK DELAYS

Date		Amount Hr.	Min.
July			
20	Shortage of trucks	1	00
22	Shortage of trucks	0	30
23	Shortage of trucks	0	30
Aug.			
2	Two trucks laid up for repairs	0	30
26	Two trucks laid up for repairs	0	10
27	Two trucks laid up for repairs	0	15
29	Truck in ditch	0	10
Sept.			
2	Truck in ditch	0	10
12	Double batch dump	0	15
13	Double batch dump	0	30
14	Double batch dump	0	25
	Trucks in repair shop	0	25
15	Double batch dump	0	25
19	Double batch dump	0	10
20	Driver overslept	1	30
	Truck hoist broken	0	10
Oct.			
4	Double batch dump	0	20
5	Truck broken down on grade	0	10
10	Double batch dump	0	20
11	Shortage of trucks—repairs	0	25
	Broken drive shaft on grade	0	45
13	2-batch dump	0	30
18	Shortage of trucks	1	55
19	Shortage of trucks	1	00
21	Truck broken down on grade	0	10
May			
18	Shortage of trucks	2	35
19	Shortage of trucks	4	00
21	Shortage of trucks	4	15
22	Shortage of trucks	3	15
23	Shortage of trucks	1	10
24	Shortage of trucks	1	15
25	Shortage of trucks	1	40
26	Shortage of trucks	0	40
	Total	31	30

TABLE VIII—DESCRIPTION OF MIXER TIME LOSSES ON ACCOUNT OF WATER SYSTEM

Date		Amount Hr.	Min.	Date		Amount Hr.	Min.
Aug.				Sept.			
12	Sprinkler plugs blown out	0	30		Changing valve	0	10
24	Boys opened forgotten water valve	1	10	20	Joint leaking	0	10
				21	Joint leaking	0	35
				22	Joint leaking	0	10
	Water filling new line of pipe	0	10	23	Changing valve	0	10
25	Plug blown out	1	15	26	Broken pipe	2	30
26	Plug blown out	2	30	Oct.			
29	Plug blown out	0	35	5	Line plugged	0	15
	Changing valve	0	10	8	Joint leaking	0	10
30	Plug blown out	0	45	14	Frozen line	2	05
31	Plug blown out	0	15	16	Changing valve	0	10
Sept.				18	Broken hose connection	0	20
1	Plug blown out	0	45	22	Changing valve	0	10
2	Broken pipe	0	55	23	Frozen line	1	10
5	Changing line	11	00	May			
12	Broken pipe	0	35	24	Line plugged	0	25
13	Leaky joint	0	25		Total	30	40
15	Leaky joint	1	00				

TABLE IX—DESCRIPTION OF TIME LOSSES ON GRADE WHICH DELAYED MIXER

Date		Amount Hr.	Min.	Date		Amount Hr.	Min.
Aug.				Oct.			
13	Short-handed crew	2	30	10	Subgrade too high	0	20
15	Grader too light	10	30	14	Subgrade too high	0	15
18	Subgrade too high	0	30	16	Subgrade too high	0	10
27	Short handed crew	0	30	17	Short-handed crew	3	10
30	Grader broken	1	30	18	Short-handed crew	2	00
Sept.				24	Poor management	10	00
13	Subgrade too high	0	25	25	Poor management	10	00
17	Short handed crew	5	30	26	Poor management	10	00
21	Grader broken	2	10	27	Poor management	10	00
22	Subgrade too high	0	10	28	Poor management	10	00
26	Subgrade too high	0	10	May			
Oct.				23	Short-handed crew	2	25
4	Subgrade too high	0	20		Total	83	00
5	Subgrade too high	0	25				

TABLE X—DESCRIPTION OF LOSSES DUE TO ADJUSTMENT OF CREW

Date		Amount Hr.	Min.
July			
20	Organising	2	30
Aug.			
2	Pump man sick, made no report	0	30
16	Breaking in new steel man	0	30
26	Puddlers laying down	0	25
Sept.			
1	Puddlers laying down	0	10
Oct.			
4	Sixteen-year old boys as cement dumpers	0	25
20	Cement dumpers quit	0	40
21	Cement dumpers quit	0	20
May			
18	Organising	1	00
	Total	6	0

TABLE XI—MISCELLANEOUS DELAYS

Date		Amount Hr	Min
July			
26	Subgrade planer off forms	0	20
Aug.			
5	Poor management, moving cement out	4	3
6	Poor management, moving cement out	3	45
25	Adjusting subgrade planer	0	30
Sept.			
22	Checking subgrade planer	0	30
Oct.			
14	No expansion joint at mixer	0	10
	Embargo on cement—failure to pay demurrage	0	45
15	Embargo on cement	4	00
16	Paving railroad crossing	0	30
17	No steel at mixer	0	20
21	Failure to watch cement shipments	1	00
May			
22	Paving bridge approach	0	30
23	Paving bridge approach	0	20
24	Dealer's failure to ship cement	4	50
25	Dealer's failure to ship cement	0	30
26	Dealer's failure to ship cement	0	45
	Total	23	15

particular case to a green grading crew with no competent foreman on the job until the spring of 1928. The preliminary grading operations covered a period of 103 days and involved the following units:

Days worked	68	Team-hours	1,396.5
Sundays and holidays	9	Tractor- and grader-hours	465.5
Rainy days	18	Gas shovel-hours	40.0
Crew laid off	8	Truck-hours	160.0
Man-hours	2,781.5		

Final Grading and Shouldering—The final grading and shouldering operations were started Aug. 11, 1927, at station 0, and by Aug. 27 the first 1,400 ft. was completed and ready for acceptance. Progress on this portion of the contract was unusually slow and unsatisfactory during the first season due to the contractor's failure to secure a competent foreman. Several attempts were made to sublet portions of the work, but in every case the subcontractor failed to complete his section, due principally to inexperience.

Frost and snow on Nov. 11, 1927, made further prosecution of the work impossible and the road was left from then until May 21, 1928, when shouldering and seeding operations were resumed under a new foreman and with a new crew.

The work had reached station 195 during 1927, but after going over the work done it was decided to begin again at station 14 and complete ready for acceptance each mile as they went along.

The new foreman was a thoroughly experienced shouldering man and made exceptionally good headway with the equipment allowed him, which consisted of one flat-bottom delivery truck of 2-ton capacity, one slip scraper and four wheelbarrows. During the latter part of the job he managed to borrow two wheelers from the county to help with the heavier portion of the excavation, but for the majority of the time the remaining excavation was done with wheelbarrows and shovels.

The costs of this final work of shouldering and seeding were reported by the foreman as being from 12 to 25c. per linear foot of roadway depending upon the location of the work, and while this is obviously high due to the equipment used, in some cases the wheelbarrows proved more satisfactory than team when the fact is taken into consideration that all of this final work was done with a traffic of from 2,000 to 3,000 vehicles a day passing over the road.

These final grading and seeding operations covered a period of 144 days as follows:

Days worked	109	Team-hours	2,993
Sundays and holidays	20	Tractor-and grader-hours	160
Rainy days	15	Truck-hours	410
Man-hours	23,480		

Thus the entire grading operations to move and place 30,847 cu.yd. of earth and trim and seed 104,277 sq.yd. of shoulders and ditches required the following total labor units:

Man-hours	26,261.5	Gas shovel-hours	40.0
Team-hours	4,389.5	Truck-hours	570.0
Tractor-and grader-hours	625.5		

Summary—An analysis of the operations on the entire project shows a decided lack of management as the main cause for losses, as the production records show that the equipment as a whole when it was kept in adjustment was capable of much higher average production than was actually maintained. The description of the causes of lost time give evidence of the same fault, and an effort was made to be particularly careful in selecting that part of the lost time which could be classified as avoidable.

During the compilation of these data it seemed possible that this particular project was an exception to the general run of paving projects in the matter of management and operating conditions, but a comparison with the records of three other contractors on projects in the same vicinity belies this supposition, as all had approximately the same percentages of lost time and in two cases even a lower average production per working hour than this one.

Tension and Bend Tests on Flame-Cut Structural Steel

By J. R. Dawson and the late S. W. Miller
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Abstract of a paper read by Mr. Dawson before the sixth annual convention of the American Institute of Steel Construction, Nov. 14, 1928.

NUMEROUS theories, both favorable and adverse, about the effect of flame-cutting structural steel have been advanced to support the opinions of those interested in the matter. By way of introduction, it may be pointed out that in cutting structural steel with the oxy-acetylene blowpipe the flame is applied in three ways:

1. Hand cutting, where the cut surface is somewhat irregular on account of the inability of the operator to advance the blowpipe steadily.

2. Hand cutting, where the end of the blowpipe is rested against a guide.

3. Machine cutting, where the blowpipe is supported by a machine with which the cut obtained is similar in smoothness to that produced by sawing or milling.

This paper contains an account of tension and bend tests applied to various structural steel specimens. All of the steels used were of normal composition.

Tension Tests—Specimens for the tension tests were taken from a ¾-in. steel plate, the web of a 24-in., 105.9-lb. I-beam and the web of a 14-in. rolled column section weighing 205 lb. per foot. Some of the specimens were prepared on a milling machine and others from adjacent material by flame cutting, the blowpipe being guided mechanically to secure a smooth face. The results are shown in Table I. As may be seen from the table, the yield point has been increased about 4,000 lb. per sq.in. for the flame-cut sections, while the other properties were not appreciably changed. Since it is the yield point that marks the beginning of failure, the increase, secured without reducing the ductility, is a very desirable thing.

TABLE I—RESULTS OF TENSION TESTS ON MILLED AND FLAME-CUT SPECIMENS

Specimen	Size	Yield Point, Lb. Per Sq.In.	Tensile Strength, Lb. Per Sq.In.	Elongation in 2 In., Per Cent	Elongation in 8 In., Per Cent	Reduction of Area, Per Cent
14-In. Beam:						
Milled	1.390 × 0.995	31,300	58,200	52.0	30.5	56.8
Blowpipe 1	1.500 × 0.995	36,100	60,300	48.5	27.0	51.8
24-In. Beam:						
Milled	1.465 × 0.625	28,000	50,700	51.5	32.2	57.2
Blowpipe 1	1.540 × 0.625	32,400	53,000	51.0	29.1	51.3
Blowpipe 2	1.520 × 0.625	32,600	53,100	50.0	28.2	58.8
Steel Plate:						
Milled 1	1.505 × 0.390	35,800	57,900	46.5	29.1	55.9
Milled 2	1.510 × 0.390	35,700	57,300	45.0	27.5	54.8
Milled 3	1.510 × 0.390	35,700	57,300	45.0	29.9	59.7
Blowpipe 1	1.545 × 0.385	39,000	58,800	48.0	28.9	60.8
Blowpipe 2	1.570 × 0.385	38,900	59,600	44.0	27.0	54.7
Blowpipe 3	1.530 × 0.385	37,850	56,900	48.0	27.8	57.5

Bend Tests—In the bend tests the specimens were bent by squeezing in a vise or pressing in the tensile-testing machine either until they were flat or until cracks had been started. Some specimens were milled, some were flame-cut in a machine and others were flame-cut by hand. Part of the hand cuts were made carefully to produce an even surface, while others were quite irregular and not representative of satisfactory work. Inspection of the results in Table II shows that elongation of specimens cut by the machine blowpipe and on the milling machine were practically the same. Elongations of the hand blowpipe specimens were not quite so good, but the decrease was very little when the cuts had been carefully made.

TABLE II—RESULTS OF BEND TESTS ON MILLED AND FLAME-CUT SPECIMENS

Material	Specimen No.	Thickness, In.	How Cut	Elongation, Per Cent in 1-In. Gage Length	Radius of Bend, In.
¾-in. steel plate	22	0.385	Milled	60	0.52
¾-in. steel plate	19	0.382	Mach. blowp.	59	0.49
¾-in. steel plate	20	0.385	Hand blowp. smooth	56	0.49
¾-in. steel plate	21	0.386	Hand blowp. rough	50	0.63
16-in. 68-lb. beam	6	Web 0.450	Hand blowp. smooth	58	0.57
16-in. 68-lb. beam	5	Web 0.445	Hand blowp. rough	58	0.61
16-in. 68-lb. beam	7	Web 0.450	Hand blowp.		0.55
	2	Web 0.628	Milled	53	0.55
24-in. 105.9-lb. I-Beam	1	Web 0.628	Mach. blowp.	54	0.62
	3	Web 0.630	Hand blowp. smooth	52	0.63
	4	Web 0.625	Hand blowp. rough	51	0.70
14-in. 205 lb. beam	10	Web 0.988	Milled	44	0.63
14-in. 205-lb. beam	11	Web 0.988	Mach. blowp.	38	0.61
14-in. 205-lb. beam	8	Web 0.992	Hand blowp. smooth	43	0.73
14-in. 205-lb. beam	09	Web 1.00	Hand blowp. rough	34	1.00
14-in. 205-lb. beam	14	Flange 1.561	Milled	49	0.57
14-in. 205-lb. beam	12	Flange 1.561	Mach. blowp.	49	0.52
14-in. 205-lb. beam	13	Flange 1.559	Mach. blowp.	47	0.58
14-in. 205-lb. beam	18	Flange 1.560	Mach. blowp.	70	2.14
14-in. 205-lb. beam	16	Flange 1.564	Hand and mach. blowp.	50	2.53

NOTE:—Specimens 7, 16 and 18 were bent so that the cut face was on the side of the specimen with top in tension and bottom in compression; all others were bent with the cut face on the outside of the curve. Elongation values for specimens 16 and 18 were obtained with the bend extensometer.

Conclusion—The information obtained in the tests described in this paper leads to the following conclusions:

1. All flame cuts should be made as smoothly as possible.

2. Structural steel is not injured by smooth flame cuts such as are produced with a sharp-cutting machine or other apparatus for getting steady travel of the cutting blowpipe and such as can be secured by experienced operators.

3. Structural steel flame cut by hand is not damaged in the material itself, but depending on the extent of the irregularity of the cut the elongation obtained in bending the rough surface is less by a small amount than the elongation with milled or machine flame-cut specimens.

Small Activated-Sludge Plant in Texas Has Special Features

Sewage Pre-Aerated Before Activation—All Air Diffused Through Porous Tubes Placed Only 4 Ft. Below Surface

By E. W. Steel

Professor of Municipal and Sanitary Engineering, Agricultural & Mechanical College of Texas, College Station

ALTHOUGH some hold that the activated-sludge process of sewage treatment is suitable for large cities only, many engineers have considered it satisfactory for small places also. One of the smaller installations is at Mercedes, a place of about 6,000 population in southern Texas. The plant there, which was put in use on Aug. 1, 1928, has two unique features which effect a considerable saving of power: pre-aeration without activated sludge and air diffusion through 4-in. horizontally placed porous cylindrical tubes suspended so their center is 4 ft. 2 in. below the flow line.

The Mercedes plant was designed to treat 0.5 m.g.d. of domestic sewage, but owing to slowness in constructing lateral sewers and house connections it has treated an average of only 0.15 m.g.d.

On arriving at the plant the sewage first passes through a settling tank consisting of two units in parallel, which will provide a retention period of 40 minutes when the capacity of the plant is reached. At present only one unit is operated continuously. The settling period with the present flow is 1.1 hours. Link-Belt apparatus pushes the sludge to a sump at the end of the tank, from which it is raised by air lifte to the sludge-digestion tank. The sludge collectors also push off the scum, which is sent by gravity to the sludge-digestion tanks.

Following sedimentation the sewage receives a preliminary aeration, without sludge, in a tank unit which is exactly the same except for length as that used for aeration with sludge. Ultimately this tank will provide 45 minutes of pre-aeration, but at present 3.5 hours is given.

After pre-aeration the activated-sludge process begins. Compressed air is applied through porous diffusers similar to filtros plates except that they are suspended cylindrical tubes, as already stated. To obtain spiral flow the diffusers are hung along the inner periphery of the aeration tank and a vertical baffle is placed so that pronounced upward current is induced. Good agitation, judging by surface conditions, is obtained.

The diffuser tubes have an inside diameter of 3 in., an outside diameter of 4.25 in. and a length of 2 ft. They are designed to pass 10 min.-ft. of air per foot of length at 2 in. of water pressure within the tube—or the same amount of air per foot of length as a filtros plate 1 ft. square, with a friction loss of 2 in. of water pressure. The diffuser tubes are suspended in pairs with a 2-in. galvanized pipe supplying each pair. Upon uncoupling a union the unit can be removed for cleaning. This minimizes the possibility of increased power cost resulting from clogged diffusers and the cost of removal for cleaning. Furthermore, any clogged unit can be cleaned without interfering with the operation of the plant.

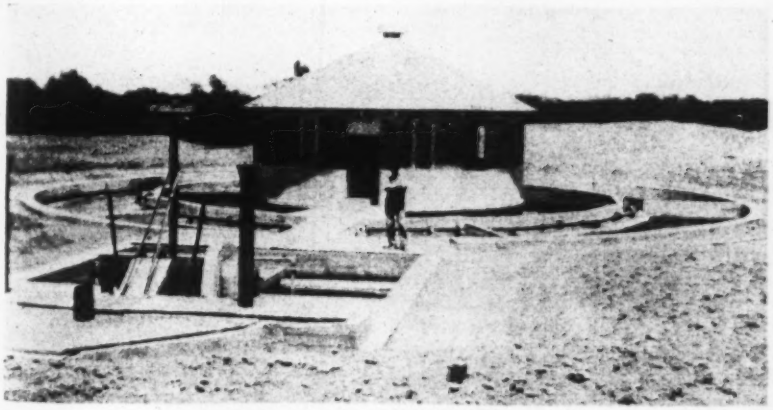
Only 60 per cent of the tank space available for aeration with sludge is now being used, the unused 40 per cent being held in reserve until the sewage flow has increased sufficiently to require it. Under present conditions the total aeration period with sludge is fourteen hours.

After aeration the mixed liquor is settled in a circular tank equipped with an involute or Fidler type of sludge collector. The present detention period is about 8.5 hours; at ultimate capacity it will be 2.5 hours. The sludge is raised by air lift and a determined part is returned, the remainder being digested in the separate sludge-digestion tank with the presedimentation sludge. The sludge-digestion chamber has a capacity of 2 cu.ft. per capita on a 6,000 population basis.

The aeration, sludge digestion and final settling chambers are arranged in very compact form, the first named being the outermost ring of a circle. A second ring is the sludge-digestion space, and the center ring is the final settling chamber. Over the final settling chamber have been placed a floor and a building in which the blowers and motors are housed.

There are three positive pressure blowers, each rated at 200 cu.ft. of free air per minute at 3-lb. pressure. Only one of these is being used at present. There are also two smaller blowers directly connected to the motors that drive the sludge collectors. These are for lifting the raw and activated sludges. The large blowers are driven by three 5-hp. motors, and two of 3 hp. each drive the sludge collectors and air lifts. No air meters have been provided and accordingly the amount of air used is estimated from the rated blower capacity.

The results of treatment were checked by samples collected by the writer and tested in the Texas Sewage Research Laboratory at A. & M. College. It was not possible to obtain a composite sample of the raw sewage, the samples taken being collected in mid-afternoon. Judging from the biochemical oxygen demand, the sewage is rather weak, although some tests made by the designer indicate that the morning sewage is an average domestic sewage. The results

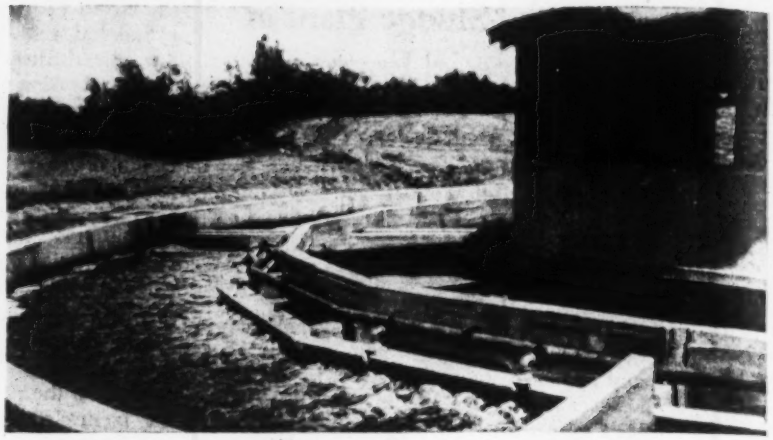


VIEW OF ACTIVATED-SLUDGE PLANT AT MERCEDES

Sewage enters presedimentation tank in foreground, passes to pre-aeration tank in part of the outer ring, at left; next continues to left in outer ring to activation compartment and then to central settling compartment covered by the motor and blower building. Activated and presedimentation sludge are digested in the ring-shaped compartment surrounding the settling compartment

of the tests are shown in the table. Samples were collected at various points in the aeration chamber and the aeration period was estimated accordingly, neglecting the effect of possible short circuiting. Samples collected from the sludge-sewage aeration chamber were allowed to settle for two hours and the clear liquid was taken for testing.

Pre-aeration had but little effect upon nitrification but apparently caused a considerable reduction in the biochemical oxygen demand. More interesting is the effect of pre-aeration upon the later aeration of the sewage-sludge mixture. English writers have mentioned the advisability of keeping sewage fresh before activated-sludge treatment, and have suggested the possible value of a short pre-aeration period. From the tests it would appear that pre-aeration has shortened materially the necessary time for aeration with sludge. The first sample, taken at the quarter point of the sewage-sludge aeration chamber, after an aeration period with sludge of 3.5 hours, indicates a sewage that is completely treated for all practical purposes, further aeration having but little additional effect. All of the samples taken after aeration with sludge, including the final effluent, were so free from suspended solids that the small-size samples made determination impracticable. The final effluent, due to its long retention in the final settling tank in contact with sludge, shows a small increase in B.O.D. and a very slight decrease in the nitrates. Only 5 per cent of activated sludge appeared after settling the mixed liquor for 30 minutes. This very small proportion was due to the return sludge valve having been throttled down too low for some days previously.



MAIN AERATOR CHAMBER IN SERVICE

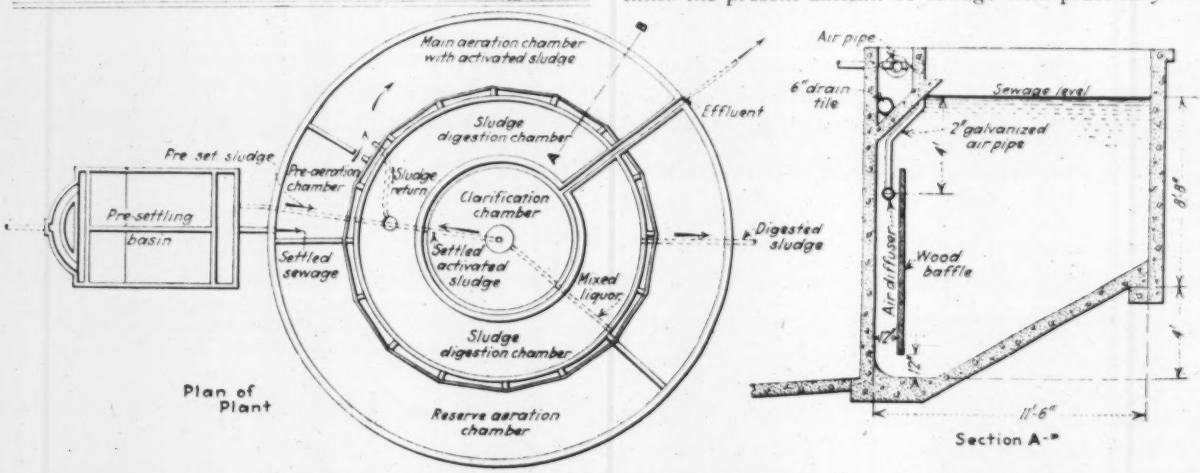
Air supply pipe parallel to wall, with branches at intervals dipping down to submerged porous air-diffusion tubes 4 ft. below surface. Activated sludge and sewage go to clarification chamber beneath building. Excess activated sludge goes to digestion chamber just outside building.

TESTS OF MERCEDES ACTIVATED-SLUDGE PLANT

	Biochemical Oxygen Demand, P.P.M.	Ammonia, P.P.M.	Nitrites, P.P.M.	Nitrates, P.P.M.	Relative Stability, Per Cent	Aeration Period, Hours	Air Per Cu. Ft. Per Gal.
Raw sewage	106.0	4.0	0.002	0.0			
Settled sewage	73.0	3.5	0.002	0.0			
After preaeration	22.0	3.5	0.015	1.4		2.5	0.24
Aerated with sludge (1)	13.6	2.5	3.13	8.0	100	3.5	0.60
Aerated with sludge (2)	9.6	1.6	3.75	9.5	100	7.0	0.94
Aerated with sludge (3)	9.6	1.6	4.38	11.0	100	10.5	1.29
Final effluent	15.0	1.2	4.38	10.0	100	14.0	1.64

The sludge-digestion tank, which is uncovered, receives the presedimentation sludge and the excess activated sludge. Although the new tank had never been seeded with ripe sludge, no odors have been perceptible. This may be taken as an indication that activated sludge and presedimentation sludge are inclined to digest peaceably together. The pH value of the sludge was 7.1.

The diffusers used and their position with their center line only 4 ft. 2 in. below the surface, instead of having all the air delivered at the bottom of the tank, may be expected to lower the cost of aeration by reducing the air pressure against which the blowers must work, a highly desirable result provided the aeration and agitation are sufficiently effective. This is apparently accomplished, for the tests indicate that aeration for 3.5 hours with sludge, following pre-aeration without sludge, with air used at the rate of 0.6 cu.ft. per gallon, brings about stability and practically complete nitrification. Upon this basis the same aeration chamber should treat four times the present amount of sewage with practically the



PLAN AND SECTIONAL DETAIL OF ACTIVATED-SLUDGE PLANT AT MERCEDES, TEX.

Involute sludge collector not shown.

same air and power consumption. An increase in the strength of the sewage may, however, have the effect of requiring more air. The air consumption of 0.6 cu.ft. per gallon includes the air wasted at the pressure relief at the blower. The net amount of air applied to the sewage is probably somewhat less than 0.5 cu.ft. per gallon.

The power consumption, as shown by power bills, is about 2,750 kw.-hr. per month, amounting to an average of 5.1 hp. required continuously for aeration, sludge collection and lifting. Upon the present basis this amounts to 34 hp. per million gallons daily. If, judging by the present performance of the plant, complete treatment may be expected after 3.5 hours' aeration with sludge, the power consumption will approximate only 8.5 hp. per million gallons daily, a remarkably small amount.

The power rate is 3c. per kilowatt-hour, making the present average daily power cost $2.70. On the basis of the present sewage flow this is a power cost of $18 per million gallons. This is not high in itself compared with many plants now operating, but, as indicated above, the plant should treat three or four times the present flow with little or no increase in power. If this holds true, the power cost will drop to from $4.50 to $6 per million gallons treated.

The great possible saving in power is no doubt due to the placing of the diffusers at a short distance below the surface. This results in a pressure of slightly less than 2 lb. per sq.in. for the blower to operate against. A further advantage is that, the diffusers being easily cleaned, the pressure against the blowers need never be allowed to increase to any extent. A low power cost is therefore assured in the future.

The plant does not have a full-time operator. The city fire marshal gives it his attention for about 30 minutes a day, during which time he oils the motors and blowers, operates the sludge collectors in the presedimentation basins and regulates the quantity of sludge entering the aeration chamber. For this he receives $25 additional pay per month.

The cost of the plant was $35,000, not including a sludge bed. Of this, $8,500 was for excavation, a disproportionately large amount due to the fact that it was practically all in water. The plant was constructed by R. W. Briggs & Company, of Pharr, Tex. W. E. Anderson, of San Benito, Tex., was the consulting engineer, and H. E. Elrod of Dallas, Tex., prepared the designs and supervised construction.

Proposed Track-Bolt Standards

A study of track bolts and nuts by the American Standards Associations has resulted in the preparation of proposed standard designs, revised from the former proposal issued in 1926. The investigations have been carried on by a sub-committee of the committee on standardization of bolt, nut and rivet proportions, in co-operation with the rail committee of the American Railway Engineering Association. These proposed standards include oval-neck bolts ½- to 1¼-in. in diameter (with special sizes of $\frac{7}{16}$-in. to $1\frac{1}{16}$-in.), elliptical-neck bolts ⅝- to 1¼-in. in diameter, and both square and hexagon nuts for all these bolts. The designs are submitted tentatively for further discussion, which should be sent to C. B. LePage, assistant secretary of the American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

France to Celebrate Centenary of Birth of Gustave Eiffel

On April 29 the Republic of France began preparations for the centenary of the birth of Gustave Eiffel on April 29, 1832. A statue of Mr. Eiffel is to be erected at the base of the tower which he designed and built at Paris about 40 years ago. In the construction of the tower pneumatic caissons were used to sink the foundations through the soft earth at the site. Such caissons had been in use in France for several years at that time, the French engineers having been pioneers in their application to foundation work.

CAISSONS FOR EIFFEL TOWER FOUNDATIONS

FOUNDATIONS READY FOR STEEL WORK

Herbert Photos, Inc.

EARLY STAGES OF TOWER CONSTRUCTION

The accompanying illustrations are reproductions of rare photographs showing the early stages of the work on the tower. The photograph of the caisson work was taken May 1, 1887.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Grout Used to Eliminate Hair-Crack Checking in Concrete Paving

By W. A. Stacey

County Engineer, Reno County, Hutchinson, Kan.

THE USE of cement grout in the elimination of hair cracks was successfully used on 11 miles of Reno County, Kan., concrete paving projects built last year. Regardless of early covering with burlap and spraying with water, minute surface cracks 3 or 4 ft. long began to show up in the paving about the time final setting was taking place. The cracks usually ran diagonally across the paving and sometimes showed a depth of as much as 1 in. when measured the next morning.

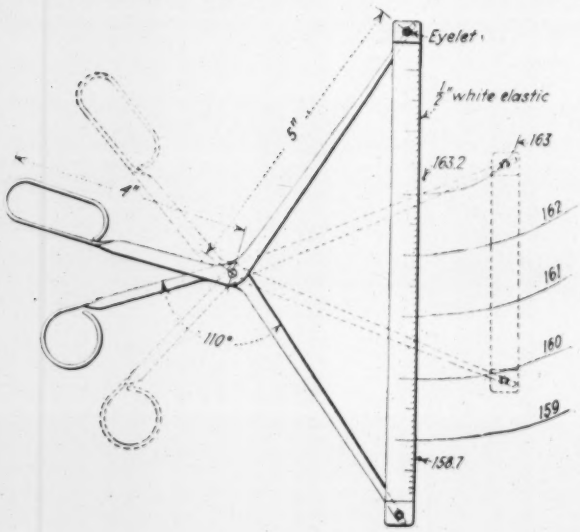
The cement grout was worked into the crack with an ordinary paint brush as soon as the burlap was removed on the morning after the concrete was placed. With the pavement now a year old, an examination shows that very few of the hair cracks have reopened after they were filled with grout. The treatment has not changed the appearance of the paving except that the grouted streaks are slightly darker than the surrounding concrete slab.

Instrument for Interpolating Contours on Large Maps

By Clare E. Slaughter

Research Assistant, Michigan State College, East Lansing, Mich.

IN LOCATING contours on a large topographic map I have found the device shown in the accompanying illustration to be a time saver and very helpful. In using, it is best to locate one point near one end of the scale and then stretch out the scale until the proper division falls on the other point.



CONTOUR INTERPOLATOR

The device consists of a short scale inked on a strip of white elastic which can be stretched by means of the scissors arrangement. The scissors can be made of sheet metal pivoted at the joint with a rivet and equipped at the tip with two lugs fitting into eyelets in the ends of the elastic scale. The eyelets are reinforced with stiff cardboard cemented to the ½-in. wide elastic, which will stretch about two and one-half times its original length. A convenient size scale can be obtained by stretching the elastic to nearly its full length, pinning it down and drawing an inch scale with 0.1 divisions. These dimensions were satisfactory for the map on which it was used, which had a scale of 40 ft. to the inch and a contour interval of 2 ft. The points as plotted were spaced from ½ to 3 in.

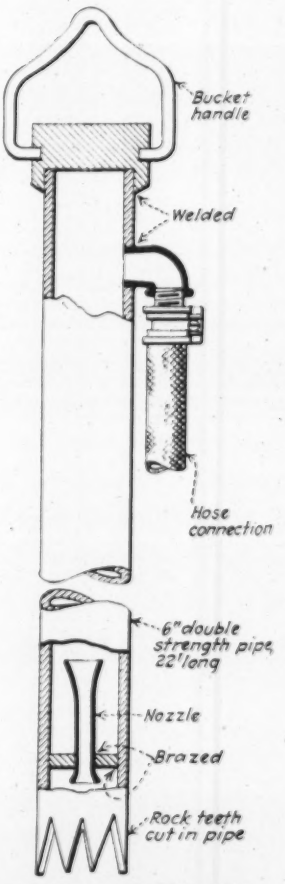
Special Jet Pile Clears Holes for Wood Piling

By M. P. Hite

Field Assistant, Construction and Repair, U. S. Coast Guard, Elizabeth City, N. C.

AS AN AID in driving wood piles on close centers through loose rock for a marine railway at Section Base No. 6, United States Coast Guard, Fort Lauderdale, Fla., the special jet pile shown in the accompanying illustration was developed by the writer and successfully used. The railway consisted of seven rails, 47 ft. out to out, laid on 12x12-in. stringers which rested directly on creosoted wood pile heads cut to grade. The piles were spaced on an average of 7 ft. and the bottom was mud underlain with sand and rock which was friable and rather loose but full of lumpy knurls like boulders. A pile striking this rock jumped aside and could not be driven accurately through it. To make the situation more difficult, the pile cutoff was practically at the ground line, even requiring some excavation at certain points, so that there was no chance to pull a pile into place once it was driven.

The problem was solved by the use of a special jet pile which was swung in the hammer heads by means of the bucket handle, spotted and lowered to cut its way



JET PILE FOR OPENING HOLE FOR WOOD PILING

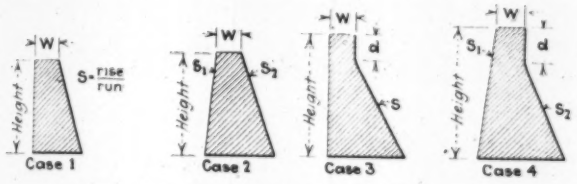
by its own weight. Where large lumps of rock were encountered, the bucket handle was laid down and the hammer dropped on the head of the jet. The teeth cut through the rock and the jet stayed plumb and true. When the jet was withdrawn, the hole filled with mud and sand, but since it was clear of rock the wood pile, subsequently driven, followed the hole accurately. The original contractors defaulted on the work, and it was completed under the writer's direction. J. Y. Gooch, of Norfolk, was superintendent on the work.

Simplified Method of Calculating Volumes of Retaining Walls

By William F. Covil

Estimating Engineer, New England Power Construction Company Boston, Mass.

IN CALCULATING the volume of retaining walls which vary in height throughout their lengths while the top width and slope of faces remain constant, use of the prismoidal formula, while simple enough in itself, is found cumbersome in application because of the necessity of calculating the area of the middle section. The following formulas, while not so simple in structure as the prismoidal formula, give the same results and are more



TYPICAL SECTIONS APPLICABLE TO SIMPLIFIED FORMULAS FOR CALCULATING VOLUMES OF RETAINING WALLS

easily applied, as it is not necessary to calculate the area of the middle section. All the data necessary for the application of the formulas are the cross-section of the wall and the height at both ends.

The formulas and explanation of terms used follows:

W = Width of wall at top (constant).
H = Height of wall at large end.
h = Height of wall at small end.

s = Slope of face = $\frac{rise}{run}$ (constant).

d = Distance below top at which slope intersects face (constant).
L = Length of wall (between heights H and h).
V = Volume of wall (in cubic yards).

Case 1. For walls with one face battered.

$$V = \frac{L}{27}\left[\frac{W(H+h)}{2} + \frac{H^2 + Hh + h^2}{6S}\right]$$

Case 2. For walls with two faces battered.

This formula may be used for calculating the volumes of earth dikes and dams and earth excavation as well as volumes of concrete walls

$$V = \frac{L}{27}\,\frac{W(H+b)}{2} + \left[\frac{(S_1+S_2)\,(H^2+Hh+h^2)}{6S_1S_2}\right]$$

Case 3. For non-overflow dams and retaining walls.

$$V = \frac{L}{27}\left[\frac{3(SW-d)\,(H+h) + H^2 + Hh + h^2 + 3d^2}{6S}\right]$$

Case 4. Same as case 3, with two faces battered.

$$V = \frac{L}{27}\left[\frac{3S_1(S_2W-d)\,(H+h) + (S_1+S_2)\,(H^2+Hh+h^2) + 3S_1d^2}{6S_1S_2}\right]$$

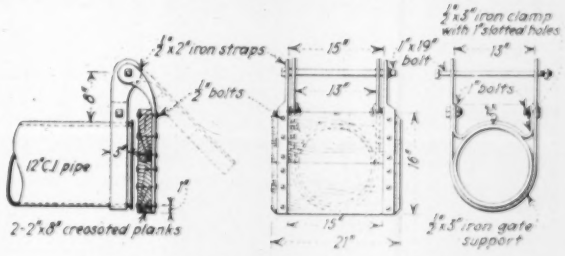
In calculating the volume of a long wall or dam with an uneven bottom profile, it is necessary to divide the wall into sections between breaks in the profile and consider the bottom as a constant slope between profile breaks, applying the proper formula to each section. The application is the same if the top of the wall changes slope. If the front and back toes of a section are at different elevations, use the average elevation and consider the cross-section base level in determining the values of H and h.

Simple Check Gate for Sewers and Drains Flowing Into Tide Waters

By A. R. Matthews

Cape May County Court House, N. J.

A SIMPLE tide gate for sewers and drain pipes emptying into tide waters is shown in the accompanying illustration. The gate consists of a creosoted lumber face swinging from a strap iron hanger bolted



DETAILS OF TIDE GATE FOR DRAINPIPES

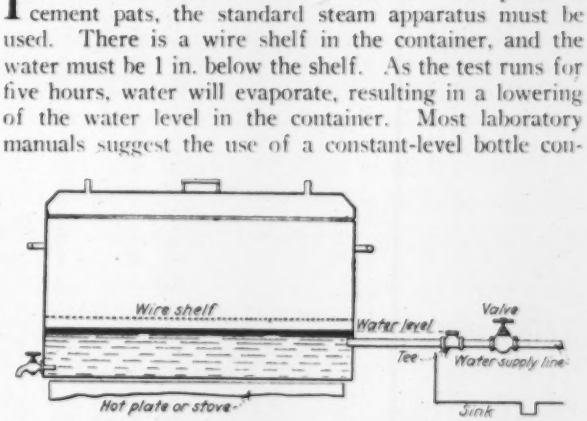
around the outlet pipe. This type gate is in use on all Cape May County storm sewers that flow into tidal waters and works very satisfactorily.

Constant-Level Attachment for the Soundness Test on Portland Cement

By Harry Tucker

Professor of Highway Engineering, North Carolina State College of Agriculture and Engineering, State College Station, N. C.

IN MAKING the soundness test on neat portland cement pats, the standard steam apparatus must be used. There is a wire shelf in the container, and the water must be 1 in. below the shelf. As the test runs for five hours, water will evaporate, resulting in a lowering of the water level in the container. Most laboratory manuals suggest the use of a constant-level bottle con-



APPARATUS FOR MAKING SOUNDNESS TESTS ON PORTLAND CEMENT

nected with the steam apparatus. I have found the method illustrated in the accompanying drawing to be much more convenient than the constant-level bottle.

The arrangement depends on connecting the water-pressure line to the steam apparatus. A valve is set in this line and a tee put in between the valve and the steam apparatus. The side opening on the tee is turned up. It will be found that a standard ½-in. tee, used in connection with the standard steam apparatus and installed as described, will have the level of the tee opening 1 in. below the wire shelf. If this is not the case, the level may be lowered by filing the tee, or it may be raised by inserting bushings.

When the apparatus is in use, the valve is open so that a barely preceptible flow of water takes place. The level of the water in the steam apparatus will thus be maintained at a constant elevation.

If the steam apparatus is used for making boiling tests on other materials—for example, brick—where the sample must be completely immersed in the boiling water, a nipple of the proper height can be screwed into the tee and the desired level of water maintained.

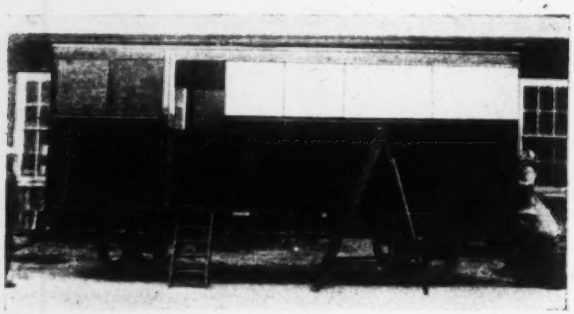
The apparatus is located near a sink, with the nipple above the sink to take care of the waste water.

Cook and Mess Wagons Mounted on Trailer Chassis

By Don M. Hoffman
Chief Surveyor, U. S. Forest Service, San Francisco, Calif.

In the construction of fire-protection roads in the national forests of California, the U. S. Forest Service is obtaining excellent results with cookhouses mounted on automobile type trailer chassis. Two sizes of mess wagons have been constructed, one 20 ft. and the other 18 ft. long.

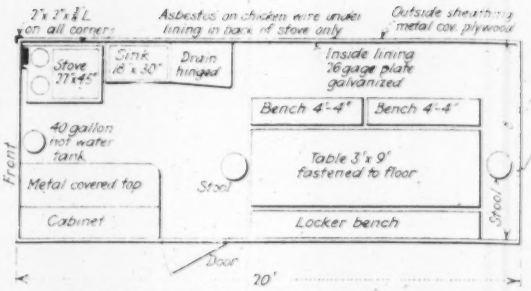
The 20-ft. wagon can easily handle fifteen men, messing the crew inside. The same kitchen would handle



COOK AND MESS WAGON READY FOR SERVICE
This is a 20-ft. wagon. The canvas curtains swing up and provide shade. Windows extend all around except behind the stove and cabinet and all are protected by copper fly screen.

from 25 to 50 men if separate space were provided for messing. The smaller wagon was designed for a ten-man outfit. The general layout for both cookhouses is the same, and good results have been had with this arrangement.

The cost of building and equipping the 20-ft. wagon was around $1,800. The cost of the 18-ft. wagon, equipped, is around $1,250. Twenty wagons of the 18-ft. size are built or being built. Designs are also being made for the construction of a cookhouse mounted directly on a 2½-ton truck chassis, in which only cooking will be done. A trailer mess wagon similar to the standard 18-ft. wagon will be towed, making a motorized boarding house of extreme mobility for crews of from 20 to 30 men.



LAYOUT PLAN OF COOK AND MESS WAGON

Letters to the Editor

An Early Wooden Bridge of Long Span

Sir—Reading with interest the account of a 200-ft. span "hand-made" highway bridge in California, in your issue of Oct. 18, 1928, I venture to send to you the following excerpt from an address by Dr. John K. Lord, of Dartmouth College, on the occasion of the 100th anniversary of the founding of Norwich University, at Norwich, Vt.

Referring to means of communication between Norwich and Hanover, Dr. Lord said: "In 1796 . . . a toll bridge was built, a remarkable structure, consisting of a single span of 236-ft. chord, arched to such a degree that the roadway at the center was about 20 ft. higher than at the ends. It was built of selected pine sticks, 60 ft. long, many of them hewed 18 in. square. It was the second bridge that ever spanned the Connecticut, the first one having been built at Bellows Falls, but it is not surprising that within eight years it fell of its own weight." F. M. Goodhue.

Mena, Ark.

Transfer of Stresses to New Work

Sir—The writer has read with great interest an article appearing in your April 25 issue, by Howard D. Hilborn. This article describes a method of reinforcing weak concrete columns and beams by adding concrete to the weak sections, the additional concrete being placed by the use of a cement gun.

There seems no doubt that, if it is possible at all to make new concrete bond perfectly to old concrete, the method pursued by the author should accomplish the desired result. However, when it comes to obtaining the working stresses in the gunite as described in the article, it does not seem possible to obtain these, except in the case where the gunite is applied to the top of a beam.

Take, for instance, the case where the beam is enlarged by applying gunite to its side. Even assuming that the original beam is relieved completely of both its live load and its dead load stresses, the maximum compressive stress in the gunite would be $\frac{15}{10} \times 650$, or 975 lb., if the stress in the old concrete is to be limited to 650 lb. per sq.in., with $n=15$ for the old concrete and $n=10$ for the gunite. And there is nothing in the article suggesting that the beams were relieved of any of their dead load stresses while the gunite was applied.

By the same reasoning, it does not seem possible to get the gunite sections in the columns stressed to 900 lb. per sq.in., if the original column sections can only take 450 lb. per sq.in.

J. C. V. Christensen,
Structural Engineer.

Cincinnati, Ohio
May 2, 1929

News of the Week

Baltimore & Ohio Not Interested in Hudson River Bridge

The Baltimore & Ohio Railroad is only an "interested observer" of the project to build a large bridge over the Hudson River at 57th Street, New York, for rail and highway traffic.

The North River Bridge Company, headed by Gustav Lindenthal, has had plans for a suspension bridge over the Hudson River in the neighborhood of 57th Street under consideration for the past 40 years. An application for approval of the pier positions and clearances has been before the Chief of Engineers, U. S. Army, for some time. Recently the *New York Times* published a report to the effect that the B. & O. had decided to use the bridge as a means of getting access to Manhattan Island for a railroad terminal. This the B. & O. flatly denies.

St. Louis Officials Charged With Graft on Lighting Contract

Indictments have been returned by the St. Louis, Mo., Grand Jury against John C. Pritchard, director of public utilities; George B. Heath, chief electrical engineer, and A. M. Ryckoff, Chicago contractor, on the charge of obtaining $175,000 from the city by false pretenses. These charges grew out of an investigation into a contract for installing electric lights under a municipal bond issue. The city claims that Ryckoff was paid for 1,592,000 sq.ft. of brick repaving which was never done. This, at the unit price of 11c. a square foot, would amount to an overpayment of $175,000.

It is believed that the present indictments are only the first move in a thorough investigation into attempts to defraud the city, and that other indictments will follow later. Pritchard and Heath are involved in the present case because they signed estimates of Ryckoff's work on which the city paid out money. Ryckoff is accused of bribery and conspiracy to defraud.

Arkansas Organizes Levee and Drainage Board

Organization of the Arkansas State Levee and Drainage Commission was completed at a recent meeting. The immediate object of the organization is to study pending legislation in Congress affecting flood control and drainage. It will also attempt to co-ordinate the efforts of the 300 or more levee and drainage districts in Arkansas, and will make surveys of tributaries of the Mississippi River and a study of the backwater situation at the mouths of the largest tributaries of the Mississippi.

Large Industrial Problems Discussed By U. S. Chamber of Commerce

Natural Resources, Power, Credit and Employees' Pensions Dealt With in Round-Table Conferences at Annual Meeting Held in Washington

CURRENT problems of industry and business were discussed actively in a group of round-table conferences which formed the chief feature of the 17th meeting of the U. S. Chamber of Commerce, held at Washington last week. With an attendance beyond 2,500, the meeting far exceeded previous ones in size as well as in importance of proceedings. Formal addresses were a minor feature of this year's program, and correspondingly more headway was made in developing the opinion of the country's business leaders.

In the presidential address William Butterworth, dealing with the joint councils of business, paid tribute to the industrial association as an agency of regulation as well as development. He described it as a means of intelligent research, of inter-industry competition, and of fostering relations of confidence between the industries and the public.

Resources and Power

Difficulties of the oil, coal, timber and water power situations were the theme of one of the most important round-table conferences. Oil and coal output restriction developed sharp difference of opinion as to the feasibility or the fairness to independent producers of attempting to restrict oil production by either agreement or governmental dictation.

Judge W. S. Bennet cited several possible courses open to the lumber industry for improvement, including more effective study of application and utilization of particular kinds of wood, and co-operative marketing. Chief Forester R. Y. Stuart emphasized the importance of maintaining a permanent wood supply; the chief present problem is how to bridge the gap from now until the time when full reforestation will make a continuing supply possible.

M. O. Leighton and Charles Keller, of the Byllesby Corporation, spoke in support of private utility enterprise in power. Muscle Shoals is no longer a problem, said Mr. Leighton, but has been disposed of by the fact that water power in the United States is obsolescent.

Rate Making and Shipping

In the conference on transportation, fixing of railroad rates by Congress was opposed, the Hoch-Smith resolution of a year ago being condemned. Withdrawal of the government from shipping operations, extension of aid to private shipping lines, and the establishment of nautical schools for training officers for merchant vessels were favored.

A. L. Scott, of Lockwood-Greene Engineers, said that the nation's major industries are on the whole economically located. Prof. R. H. Lansburgh, University of Pennsylvania, described the great increase of output resulting from modernization of equipment and reduction of man-hours per unit. He pointed out, however, that some communities are backward and others progressive with respect to plant modernization. The old practice of amortizing factory equipment over terms as long as 20 years, as practiced up to 10 years ago, is now wholly erroneous.

Pensions and Retirement

In the conference on employer-employee relations, retirement and pension plans were the principal subjects. Homer Ferguson, of the Newport News Ship Building & Dry Dock Company, commended the pension system warmly. J. C. Clark, of the Southern Pacific Company, emphasized the importance of actuarial considerations in setting up a pension system. M. W. Alexander, of the National Industrial Conference Board, urged that the employer must solve the retirement problem himself or accept the alternative of legislation; seven states now have compulsory old-age pension laws and legislation was introduced in 20 other states during the last session. It was emphasized also that the economic independence of the employee must be built up not by pensions alone, but also by means of savings plans, insurance and the like.

City Planning and Financing

Municipal problems were discussed in a separate session. There was strong advocacy of municipal planning and particularly of regional planning—the latter more particularly with respect to thoroughfares—as a means of improving living conditions. The older cities of the East, it was suggested, are more difficult subjects for effective planning than western cities with their wider streets and less developed properties. One speaker advocated long-time budgeting of municipal expenditures.

Trade Practice Conferences

There was active discussion of the effectiveness of trade practice con-

ferences as conducted by the Federal Trade Commission, with general sentiment supporting the system. Col. Nelson B. Gaskill, former chairman of the commission, criticised a tendency for a commission to force rules upon industry by amending those submitted by the industrial conferences; he also suggested judicial ratification of trade practice rules so as to put them in a category of legally enforcible prescriptions. A. F. Myers, another former chairman, defended the procedure.

City Traffic and Public Safety

Parking was a prominent item among the subjects discussed in the conference on "Traffic of the City and Its Trade Area." Alfred Reeves, of the National Automobile Chamber of Commerce, asserted that the disadvantages of parking have been largely over-emphasized, and that a reasonable parking period must be permitted in most city sections; that a no-parking prohibition would kill retail business. Other elements of his arguments were reduction of signal lights, use of wave system of light installation, adoption of uniform traffic regulations, single-headed traffic control aided by a traffic engineer; greater freedom for the construction of garages, now often prevented by zoning laws; and the provision of broader thoroughfares and by-pass roads to eliminate congestion.

Pleas for more active community work in both health and safety measures, and compulsory automobile insurance, were discussed in the conference on life and property conservation. E. C. Stone, of Boston, said that compulsory automobile insurance has failed to prove successful in Massachusetts in two years' experience, and there are bills before the legislature to amend or repeal the act.

Credit Supply

Credit control and the activities of the Federal Reserve System constituted one of the most lively discussions. Views in this field diverged widely, in particular with respect to the Federal Reserve Board. Almost all of the speakers expressed themselves as against the excessive speculation of recent months, but no one offered concrete suggestions for limiting circulation without at the same time tightening up business credit. No sentiment was expressed for legislation intended to either regulate the Stock Exchange or to increase or limit the powers of the Federal Reserve Board.

Jesse V. Craig, president of the National Association of Securities Commissioners, of Lincoln, Neb., spoke on the growth of investment trusts, which he would call "investment companies," and expressed himself favorably of their possibilities and functions. Supervision of such corporations is necessary, however

Other Subjects Discussed

An extended discussion of the tariff, which was marked by warnings that the tariff principle be not pressed too far, and of growing taxation were also important features of the meeting.

C. H. Cahan, member of the Canadian Parliament, speaking of the St. Lawrence waterway project, suggested restricting present consideration of the question to the international section of the river, as "the United States does not really need, and Canada is not prepared to concede to the United States, any rights or privileges in the Quebec section of the river in addition to those which are now granted to the shipping and commerce of the United States." He also remarked that the project would be more favorably entertained in Canada if it were made clearly apparent "that the Federal Government of the United States has determined that the present diversion of the lake water at Chicago, which was deemed to be a breach of international comity, shall forever cease, and that the waters of the Great Lakes and of the River St. Lawrence shall never again be diverted into another watershed."

Increased Highway Appropriation

A resolution was passed by the Chamber favoring increase in the provision of federal funds for the interstate highway system. Calendar reform with a view to making the fractional periods of the year more adapted to the comparability of business records was also favored.

William Butterworth, of Moline, Ill., was re-elected president. A. J. Brosseau, of New York, R. R. Ellis, of Memphis, and Paul Shoup, of San Francisco, were re-elected vice-presidents. W. R. Abbott, of Chicago, and C. W. Lonsdale, of Kansas City, were newly elected vice-presidents. Julius H. Barnes, of New York, was elected chairman of the Board of Directors.

Drexel Institute Dedicates New Engineering Building

Formal dedication of the new $750,000 Curtis Engineering Building of Drexel Institute, the gift of Cyrus H. K. Curtis, took place May 2 at Philadelphia. The new building contains mechanical, electrical, chemical, civil and municipal engineering laboratories of the most modern type, in addition to classrooms, drawing rooms and a museum. It is a unit in the expansion program which has resulted in the adding of more than $2,000,000 in physical plant and equipment in four years.

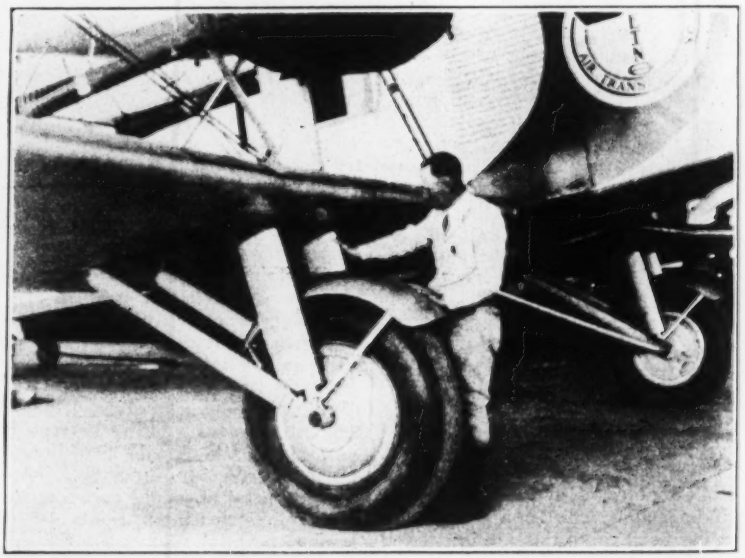
Ulen & Co. to Move Offices to Boyhood Home of Founder

On April 1 Ulen & Company, contractors, now located at 120 Broadway, New York City, removed their general offices to Lebanon, Ind., where Henry C. Ulen, founder of the organization, was born. After having spent the greater part of his business life away from there, he returned about six years ago and started to develop a community. This proved a success and various heads of the organization agreed it would be wise to move the offices to Lebanon.

Twelve members of the company have purchased lots there and homes have already begun to be constructed. The main office building is being erected in the town of Lebanon, which is about 26 miles north of Indianapolis.

The officials of the company believe that their entire business can be handled as well in Indiana as in New York. They will still maintain an office in New York to expedite ocean shipments.

WHEELS AND LANDING GEAR OF TRANSPORT PLANE



Airport runways and landing strips must be designed to withstand impact and the suction created by the wind stream from propellers. Some idea of what must be resisted may be gained from this view of the wheels and landing gear on a tri-motored twelve-passenger transport plane. The landing speed is about 55 m.p.h., weight about 8 tons, loaded. The wheels have shock absorbers, roller bearings, 44x10-in. tires and brakes may be applied to each wheel separately or may be applied to both together.

Arthur Davis Resigns as Head of Mokelumne Project

Arthur P. Davis, for the past five years chief engineer and general manager of the East Bay Municipal Utility District, Oakland, Calif., in charge of the construction of the Mokelumne River water project which is nearing completion, has resigned effective May 20. Mr. Davis has accepted an appointment as chief consulting engineer for irrigation work to be done by the Russian Government. He sails from New York on June 1. Mr. Davis will make his headquarters at Tashkent, Turkestan, where a large project on which he reported in 1911 is soon to be built. Mr. Davis was chief engineer of the U. S. Reclamation Service from 1909 to 1914 and continued as director from 1914 to 1923.

Propose to Triple Federal Aid Highway Appropriation

Increasing the annual federal aid highway appropriation from $75,000,000 to $225,000,000 is proposed by a resolution introduced into Congress by Rep. McLeod, of Michigan. Automobile registration has increased from 8,000,000 in 1920 to 24,000,000 in 1929 while the federal aid programs have remained practically the same, according to the resolution. The resolution further states that failure of the federal appropriations to keep pace with growing traffic demands is tending to stifle the automobile industry.

Reorganized Contracting Firm Retains Original Name

In the reorganization of the firm of contractors which is building the dam across the San Gabriel River for the Los Angeles County Flood Control District, the firm name remains the same, Fisher, Ross, McDonald & Kahn, Inc. A short time ago Charles R. Ross sold out to McDonald and Kahn, holding for legal purposes one share of the stock in his own name. Since that time he has re-purchased his entire interest, and the firm now stands as it did in the beginning. The work at the dam is under the complete supervision of Andrew Cassell, formerly field superintendent for the contracting firm of McDonald & Kahn, and Harvey Slocum, who is field superintendent.

Philadelphia Gas Works Selects New Leader

Following the resignation of Paul Thompson as president of the Philadelphia Gas Works Company, Conrad N. Lauer, vice-president of Day & Zimmermann, Inc. was elected to that office. Mr. Lauer has been connected with Day & Zimmermann since 1902, is the author of "Engineering in American Industry," a member of the council of the American Society of Mechanical Engineers, and a member of the Engineers Clubs of Philadelphia and New York.

Detroit Man Refused Injunction Stopping Waterworks Project

Alleges New Intake Will Draw Only Polluted Water—Would Use Lake Huron as Source

JOHN H. CALLAHAN, acting for himself as a taxpayer, began proceedings in the Circuit Court of Wayne County, to enjoin the Board of Water Commissioners of Detroit from constructing the additional water project. Callahan, through his attorney, secured a temporary restraining order May 1, on a petition setting forth in fifteen paragraphs reasons why a permanent injunction should be granted. He alleged it would be impossible to convey a supply of good water to the water consumers of Detroit because of the location of the intake, and further stated that a pure and wholesome supply could be obtained from Lake Huron.

Assistant Corporation Counsel Paul T. Dwyer, acting as attorney for the Board, on Monday, May 6, presented to Judge Lamb of the Circuit Court the Board's answer, reinforced with a number of affidavits from responsible engineers and persons conversant with the water situation. He also argued that the Court was without jurisdiction, and quoted a number of cases showing that the Court could not interfere by means of an injunction with the performance of an administrative act in the constructions of a public improvement. He further questioned the plaintiff's standing in court because the plaintiff sued as a taxpayer rather than as a rate payer, the funds of the Board of Water Commissioners being secured only through water rates.

Judge Lamb directed the plaintiff's attorney to again appear in court May 7, with arguments sustaining the right of the plaintiff to sue as a taxpayer. He appeared, but endeavored to try the case on its merits. Judge Lamb then dissolved the temporary injunction on account of lack of jurisdiction.

Duty on Cement and Brick in New Tariff

Cement, brick, tile, plate glass, and shingles are among the construction materials subject to tariff changes in the bill reported on May 6 by the ways and means committee of Congress. The portland cement industry has won the first round of its fight against the Belgian product which, it is claimed, has depressed the seaboard market in this country. Cement is assessed at 8c. per hundred pounds, including the weight of container, an equivalent of 30.4c. per barrel.

That one-tenth of the common brick used in New York's building program has been of foreign make in recent years is named as a principal cause why all classes of brick not especially provided for have been taken from the free list and made dutiable at $1.25 per thousand.

Dredge Wrecks Drawbridge

The last of Chicago's old swing bridges over the Chicago River was put out of commission on April 30 by a hopper hydraulic dredge which knocked the Clark St. bridge from its turntable. The bridge was about half open and was being swung for the passage of the boat, which is said to have been approaching at too high a speed, so that it struck the corner of the span, the end of one truss wedging against the upper deck so that the vessel could not be removed until part of the bridge was cut loose the following day. Meanwhile, one channel was entirely blocked and the other had only a narrow opening, owing to the overhang of the bridge and the piling in connection with the new structure.

For the convenience of the public on this busy street it had been decided to build the new bascule bridge while keeping the old span in service. The foundations had been built and work commenced on the superstructure. In view of the expense and time that would be involved in restoring the swing span to service it is expected that the old span will be removed and traffic detoured until the bascule bridge is completed next summer.

The Clark St. bridge, built in 1889, was 208½ ft. long, with three through trusses. It was reinforced ten years ago, as it had deteriorated badly and funds were not available for a new structure. As described in *Engineering News-Record* of May 15, 1919, page 956, new bottom chords were built above the floor, for convenience of erection, and each floor beam was supplemented by a pair of I-beams.

Virginia Stream Pollution to Be Investigated

A co-operative study of pollution on streams in Virginia, in accordance with a program adopted in November, 1928, was started about May 1 under the immediate direction of Harry A. Bailey of Minneapolis, Minn., as sanitary chemist.

Included in the membership of the co-operative committee are: Major A. Willis Robertson, of the Virginia Commission of Game and Inland Fisheries, chairman; W. E. Carson, chairman, State Commission on Conservation and Development; Richard Messer, chief engineer, State Department of Health; Dr. Mosby G. Perrow, Lynchburg, representing the League of Virginia Municipalities; M. B. Mount, Lynchburg, of the Izaak Walton League; and also representatives of the West Virginia Pulp & Paper Company, the Mathieson Alkali Works and other industrial concerns.

The Virginia Polytechnic Institute and also the University of Virginia and the Virginia Military Institute are to co-operate with the other agencies named. It is estimated that the cost of making this contemplated survey will be $10,000 a year. There being no state fund directly available for the work, a subscription of $5,000 has been made

by the Virginia Manufacturers Association and of $2,500 by the State Commission of Game and Inland Fisheries. The work in the first year will be on the south fork of the Shenandoah River and the north and south forks of the Holston and Roanoke rivers. Studies will also be made of the James River and its tributaries, as needed to supplement work already done by the city of Richmond.

After graduating from the University of Kansas, Mr. Bailey served a year as city chemist of Lawrence, Kan. He then took charge of the laboratory at the University of Michigan, maintained by the U. S. Public Health Service in connection with the stream-pollution investigations of the Mississippi River. Since October, 1927, he has served on the engineering staff of the Metropolitan Drainage Commission of Minneapolis and St. Paul, carrying on the Mississippi River studies just mentioned.

Montreal Calls for Bids on Two New Bridges

Bids have been called for by the city of Montreal for the construction of two bridges over the Back River, the estimated cost of which will be $2,300,000. The first of these will be of 5 spans, 1,550 ft. in length and 70 ft. 6 in. in width, accommodating six traffic lanes and two sidewalks for pedestrians. It is to be of reinforced concrete. The second, the LaChapelle bridge, will be of 3 spans, 1,026 ft. in length, 52 ft. in width, with four traffic lanes and two sidewalks. The piers will be of concrete, while the arches and spans will be of steel.

Maryland Governor Proposes $4,000,000 Road Program

Road improvements in Maryland to cost about $4,000,000 are included in a program prepared by Gov. Albert C. Ritchie. The General Assembly, now in session, is expected to pass the necessary legislation providing for loans for the purpose. The program as prepared by the Governor includes the following:

Widening Baltimore - Washington Boulevard between Baltimore and Savage from 20 to 40 ft. and construction of two spur highways leading into Washington, to cost $1,160,000.

Completion of the belt-line highway in Baltimore, to cost $800,000.

Construction of Eastern Shore Boulevard from the proposed Annapolis-Claiborne ferry terminus on Kent Island to Hillsboro, Caroline County, to cost $535,000.

Construction of approaches to the proposed Chesapeake Bay bridge, to cost $480,000.

Construction of road from Sunderland, Calvert County, to connect with the Crain Highway near Upper Marlboro, to cost $500,000.

Construction of 25 miles of shouldering on the National Pike, to cost $375,000.

Construction of piece of road in Garrett County to complete the Northwestern Turnpike, to cost $150,000.

Brief News

A COMMISSION of three men, authorized by the 1929 session of the Legislature, has been appointed by the Governor of West Virginia, with the ultimate purpose of freeing all bridges, both intrastate and interstate, which touch that state. The commission will take up this work immediately.

TO PREVENT A RECURRENCE of sewer scandals such as that recently unearthed in Queens County, New York City, Governor Roosevelt of New York has signed a bill providing that in local improvements where the cost is partly borne by local assessments contracts can be awarded only by a vote of three-fourths of the Board of Estimate and Apportionment, provided the lowest bid exceeds by $10,000 the estimated cost of the project.

DISCONTINUANCE OF TOLLS on the Philadelphia-Camden bridge can be accomplished in 1941 if the ratio of increase in traffic continues, according to the bridge commission's annual report to the New Jersey Legislature. This date is approximately five years in advance of the time originally estimated. The toll charge is 25c. per automobile. During 1928, 9,725,470 vehicles crossed the bridge, of which 8,260,066 were passenger cars and light delivery trucks.

CEDING OF JURISDICTION over the Rocky Mountain National Park to the federal government is believed to have paved the way for the beginning of construction work in the near future on the new $500,000 scenic highway of the park, plans for which were announced by the government last fall. The road will be approximately 19.4 miles long. The new road will be south of the Fall River highway and will handle two-way traffic. The grades will be light, it is said.

REORGANIZATION of the Arkansas State Highway Department is provided for in a bill which has passed the legislature and has been signed by the Governor. By its terms the elective office of highway commissioner is abolished and the Governor will appoint all the members of the highway commission. Sponsors of the new law point out that the appointed commission will tend to remove the highway department from politics. Governor Parnell has reappointed all of the present members of the commission. It is stated that there are no changes planned in the engineering personnel.

THE UNITED ENGINEERS & CONSTRUCTORS, INC., of Philadelphia, Dwight P. Robinson, president, announces that it has recently incorporated in Canada as the United Engineers & Constructors (Canada), Ltd., with offices in Montreal, and is prepared to undertake the same type of work in Canada that the company does in this country and abroad, particularly specializing in the design and construction of manufacturing plants, power developments and railroad work.

Small New Hampshire Dam Gives Way

Property loss estimated at from $350,000 to $500,000 was caused by the carrying away on May 3 of a small dam at the head of the Mohawk River in New Hampshire. The resulting flood virtually wiped out the village of Kidderville, carrying away fifteen houses and barns, and also damaged a number of houses in the town of Colbrook. The dam was built to regulate the over-flow from a small lake into the head-waters of the Mohawk River, a tributary of the Connecticut. No details regarding its construction are yet available. It is believed that the failure was caused by the heavy rainfall which had occurred during the preceding week, raising the level of the lake. No lives were lost as ample warning was received by the inhabitants of the flooded region.

First Contract Awarded for N. Y. Elevated Highway

Award of a contract for the construction of the first section of the New York City express elevated highway along the Hudson River was made May 2 by the Board of Estimate to James B. Stewart and Company for $4,547,489. The board rejected the lowest bid, that of the H. B. Greene Contracting Company, for $4,198,972, despite the protests of officials of the latter concern. This action was taken on the grounds that the Stewart company, which has handled many large contracts for the City has a more convincing background than does the lowest bidder.

Ground breaking ceremonies on the first section of the highway, extending from Canal Street to 22nd Street, will be held May 24. Julius Miller, president of the Borough of Manhattan, states that the first section should be completed within a year, and the entire project within eighteen months. Bids for the remaining section will be received within a few weeks.

Mount Hope Bridge Cables to Be Subject of Investigation

A thorough investigation of the Mount Hope Bridge cable failure is to be undertaken by the Bureau of Standards acting as an impartial fact-finding agency to study the basic problems involved. Five of the bureau personnel have been in the field collecting specimens of the cables which failed and further efforts are being made to secure sufficient quantities of the unfabricated materials. The Engineering Mechanics Section and the Metallurgical Division of the bureau will work jointly, the scope of the investigation depending somewhat upon the specimens of wire available.

It is not possible to predict the course of the experiments since the causes of failure are yet hardly to be guessed. Inasmuch as the investigation probably will have to be conducted from regular bureau funds unless special appropria-

tions become available, the work is expected to go slowly in order that a full study can be made. Not only will tests be made on the Mount Hope materials but it is expected that other types and sizes of cable will be included in the analysis to give comparative information. The investigation will doubtless include tests of galvanized or coated strands to determine the effect on the propagation of a notch through such duplex materials. Both static and continued stresses are to be considered.

Engineering Positions Open

Applications will be received by the Maryland State Employment Commissioner, Baltimore, Md., until May 15 from those who wish to take an examination for the position of chief engineer of the Maryland Public Service Commission, succeeding H. Carl Wolf the present chief engineer, who has resigned to accept another position. Candidates are required to have a thorough knowledge of public utility service and valuation methods, as well as expert ability in preparing engineering reports, estimates and specifications.

The United States Civil Service Commission, Washington, D. C., will receive applications until June 5 for several positions as draftsman, at entering salaries varying from $150 to $189 per month.

Arizona Public Health Assn. Holds Annual Meeting

The second annual meeting of the Arizona Public Health Association was held April 16 and 17 at Prescott, Ariz., with a total registration of 85, including Governor John C. Phillips of Arizona and R. J. Stroud, State Superintendent of Public Health. The sections were divided into three groups: The Health Officers Session, Water and Sewage Session, and Dairy Inspectors Session. A constitution and by-laws were adopted based on the American Public Health Association constitution. The new officers elected are: President, Dr. H. T. Southworth, Prescott; vice-presidents, George T. Grove, Tucson, and Arthur J. Kline, Prescott; secretary-treasurer, Miss Jane H. Rider, Tucson.

Canada Rejects Power Project Along St. Lawrence River

The Canadian Government, on April 29, rejected a bill authorizing the construction of a gigantic power-canal project paralleling the St. Lawrence River from Sorel, Que., to the southwestern limits of Montreal Harbor, and thence to Cornwall, Ont., and ultimately the construction of a new Welland canal and further canalization work up through the Great Lakes. No estimate was given as to the total expenditure required, but the bill provided that the promoters must spend at least $10,000,000 within two years should the authorization be granted.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Seek Aid on Flood Control Amendments—River and Harbor Advocates Active

President Hoover's support on various amendments to the flood control act will be sought this week by a nonpartisan committee of Senators and Representatives from the Mississippi Valley states. The legislators from the Mississippi Valley are anxious to secure congressional action at this session interpreting the law so that there can be no doubt of the intent of Congress that the government acquire flowage rights before any floodway construction is begun. They also want to make mandatory the installation of gates or other form of control at the head of these floodways. Another pending amendment which will be urged will make it necessary for the Federal Government to provide for local drainage, while still another would require the purchase of lands which are made subject to overflow as a result of the construction of levees on the opposite bank of the river. It is anticipated also that the President will be asked to delay the actual award of construction contracts in the New Madrid and Boeuf floodways. It is argued that there still is a large amount of work to do on the main river levees and that the diversions can be held in abeyance, pending a review of that phase of the adopted plan.

The flood control committee of American Engineering Council will lay its recommendations before the meeting of the Administrative Board, which will be held in Washington May 24 and 25. Gardner S. Williams is the chairman of this committee. The other members are Baxter L. Brown, John R. Freeman and Arthur E. Morgan.

The Hudson River Bridge

As the result of assurances by the War Department that a decision will be reached soon regarding the application of the North River Bridge Company to build a bridge across the Hudson at 57th St., New York City, interest is centering in whether or not the Chief of Engineers will consider a bridge at this location a sufficient distance above the major part of the port activities. It has been stated upon several occasions that the policy of the Corps of Engineers is to refuse a permit for a bridge, regardless of clearances, where it is believed that the structure would restrict the activities of a major port.

In the last decision on the proposed Hero-Hackett bridge in New Orleans, it was pointed out that the permit was refused largely because the Chief of Engineers believed that any bridge in the suggested location would interfere with the development of the port. At New Orleans, however, it was claimed that fifty per cent of the activities of the port are above the bridge site, while in the case of the proposed North River bridge, the army engineers believe that the location is on the border line of port development.

It is apparent that whatever decision is reached by the Chief of Engineers will be based primarily on the statistics presented to show the trend of the port activity. The plans under consideration provide for a span of 3,280 ft. The vertical clearance will be 175 ft. for 500 ft. in the center, 152 ft. at the New York pier head and 147 ft. at the pier head on the New Jersey side.

Delaware Channel Deepening

No evidence of support for Philadelphia's 40-ft. channel project was forthcoming at the hearing before the Board of Engineers for Rivers and Harbors May 3. Local interests contended that a controlling depth of 40 ft., with corresponding increases in the width of the channel, are essential if the commercial future of the port is to be provided for adequately. Apparently the Board was not convinced that the very large expenditure involved would be justified, in view of the fact that such a large proportion of the world's commerce is carried in vessels which can use a 35 ft. channel.

Complaint also was entered against the rate of progress being made with port work now authorized. After twenty years the project is still 22 per cent unfinished, it was declared. Emphasis was placed upon the expenditure of $40,000,000 by the city in providing piers and docks and on the necessity for providing a deeper channel to the navy yard.

Monterey Harbor Plans

Judging from questions asked during the hearing given the advocates of a breakwater for the harbor at Monterey, Calif., the members of the Board of Engineers for Rivers and Harbors apparently have doubts as to the effectiveness of such a breakwater in reducing surges to negligible proportions. The original project requires railroad construction from Fresno to Monterey. A careful study will have to be made to determine whether or not this service can be performed sufficiently well by motor trucks to permit of the maximum development of the harbor.

Tennessee River Development Urged

Protests against the continued removal of the upper Tennessee River from development has been lodged with members of Congress and with various Federal agencies by the Tennessee Railroad and Utilities Commission. Harvey Hannah, Porter Dunlap and M. R. Hill, the members of the Commission, were accompanied by the commission's chief engineer, and an assistant to the attorney general of the state. Members of the commission expressed particular disapproval with the plan for the disposition of Muscle Shoals as set forth in the revised Madden bill. With minor exceptions, the commission believes that Tennessee's interests would be best safe-

guarded were there no interference on the part of Congress with the operation of the water power act as it pertains to the development of the upper Tennessee.

Start Alaskan Mapping

This year's mapping expedition to Alaska is getting under way. The tender *Gannet*, towing a covered 140-ft. barge which houses the photograph laboratory and the airplane machine shop, is ready to sail from Seattle. A few days later four Loening amphibian planes will take off from Santiago. They will stop at Seattle to pick up R. H. Sargent, a topographic engineer of the Alaskan branch of the U. S. Geological Survey. The actual mapping, however, will be in charge of Lt. Commander A. W. Radford, of the Navy Department, with Lieutenant E. F. Burkett as his executive officer. This year's mapping program is to cover 12,000 sq. miles, including the islands of Chichagof, Baranof and Kuiu. Flight lines 50 miles long will be flown over the area at three-mile intervals. Most of the pictures will be vertical exposures from an altitude of 10,000 ft. Numerous oblique shots will be made, however, as these are of assistance to the Forest Service and the Federal Power Commission in connection with their work. No ground work will be included in this survey.

Personal Notes

WAYNE E. TIMMERAN, for the past six years village engineer of Massena, N. Y., has been appointed village manager of Saranac Lake, N. Y. Mr. Timmeran, during his service in Massena, has supervised many village improvements, including the new water works system.

GUY HALL has resigned as county engineer of Gove County, Kans., to become county engineer of Logan County in the same state.

F. M. DAVISON, retired army officer, has been appointed engineer of maintenance in the Highway Department of the District of Columbia. He has been connected during the past ten years with the construction divisions of the Kentucky and Florida State highway departments.

E. H. WEILEMAN, of Charlotte, N. C., for the past seven years associated with Mees & Mees, Inc., has accepted a position with the engineering department of the Electric Bond & Share Company in New York City.

Lt.-Col. WARREN T. HANNUM, Engineer Corps, U. S. Army, has assumed the post of district engineer at Baltimore, Md., relieving Lt.-Col. CHARLES R. PETTIS, who is now post commander at Fort Logan, Col.

B. E. TORPEN, construction engineer, water department, City of Portland, Ore., who has been in charge of construction on the Bear River Dam, has completed that work and accepted a position with the Electric Bond & Share Company, New York. Prior to his connection with the City of Portland, Mr. Torpen was construction engineer for the City of Tacoma on its Cushman project.

ALLEN J. SAVILLE has been appointed county zoning engineer of Arlington County, Va.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

NATIONAL FIRE PROTECTION ASSOCIATION, Boston; annual convention, Memphis, Tenn., May 13-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; annual meeting, Atlantic City, N. J., June 24-28.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

* * *

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION held a meeting at Stevens Institute of Technology, Hoboken, N. J., on April 27. About 200 members were present. The chief speaker was Johnson O'Connor, in charge of personnel work for the General Electric Company.

THE ENGINEERS CLUB OF MINNEAPOLIS at a recent meeting elected five additional life members, bringing the total of this class to fourteen. The honor was given as the result of 25 years of active membership in the club.

THE BOSTON SOCIETY OF CIVIL ENGINEERS on May 15 will hear James W. Rollins, vice-president of the Blakeslee-Rollins Corporation, speak on "Pier Construction for the Mid-Hudson Bridge at Poughkeepsie, N. Y."

Obituary

EUGENE HILARIAN ABADIE, consulting engineer of Washington, D. C., was instantly killed April 27 in an automobile accident. He was born in Missouri and graduated from Washington University, after which he was engaged for 12 years in the construction and sale of electrical machinery. In 1903, he formed the firm of E. H. Abadie & Company, engineers and contractors, which designed and constructed a heating plant and power house for the State of Missouri at Jefferson City, designed and built underground conduits in Louisville, Ky., assisted in the location of the New Orleans and Baton Rouge Electric Ry., and designed a plant for stripping coal with steam shovels for the Lilly Jellico Coal Company of Lilly, Ky. Mr. Abadie, as a consulting engineer, later engaged in a number of activities in the public utility field. In June, 1917, he was commissioned major of engineers, but was soon transferred to the Construction Division of the Quartermaster Corps and later advanced to the grade of lieutenant colonel. He had charge of the construction of Camps Huston, Dodge, and Lee, as well as many smaller military installations. In 1919 he became controller of the Division of Operations of the U. S. Shipping Board, and in 1920 returned to private life as a consulting engineer. He was a member of the American Society of Civil Engineers.

JOHN E. L. MONAGHAN, of Boston, Mass., died April 29 after a brief illness. A graduate of the Massachusetts Institute of Technology in 1906, he had spent practically his entire life in the public works department of the city of Boston, being identified with some of the largest sewer construction projects in the city. He was a member of the Boston Society of Civil Engineers and a past president of the Municipal Engineers Association of Boston.

DAVID LINDSAY STRUTHERS, city manager of Gastonia, N. C., died April 29 at Wilmington, N. C. Graduating from the University of North Carolina in 1910, Mr. Struthers, after some experience in drainage work, became assistant engineer for the city of Wilmington. Four years later he was advanced to the post of city engineer. During the war and for some time thereafter he worked as civil engineer for the Carolina Shipbuilding Corporation, later the George A. Fuller Company, Carolina Shipyards. In October, 1921, he became designing highway engineer of Gaston County, and in May, 1923, city manager of Gastonia. He was an associate member of the American Society of Civil Engineers.

EDWARD H. RAINBOTH, of Ottawa, Canada, died April 25 of heart disease at the age of 74. Most of his engineering career was spent in western Canada in connection with the laying out of many cities and towns in the prairie provinces. During recent years Mr. Rainboth practiced his profession in Ottawa.

BARNEY NORTON, 79 years old, Indianapolis, street and railroad contractor, died recently in a hospital following a long illness. He was a native of Ireland, but came to America with his parents when 5 years old. He had had several railroad and street construction contracts in and about Indianapolis and also built some of the flood retaining walls along White River inside the city limits.

FRANK H. SPRAGUE, former N. Y. State Barge Canal engineer, died at his home in New Berlin, N. Y., on April 28, death being due to heart trouble. Mr. Sprague in early life had charge of building six miles of the Chicago Drainage Canal, after which he built 300 miles of railroad from Coffeyville, Kan., to Oklahoma City, Okla. Before coming to Rome, N. Y., where for two years he was head of the Rome Water Department, he was in charge of large canal construction at Albion, N. Y.

Construction Equipment and Materials

Road Equipment Makers Seek To Eliminate Regional Exhibits

Each member of the Highway Industries Association, the manufacturers division of the American Road Builders Association, has received a letter from the board of directors of the association in which is included, for signing, a pledge of agreement not to exhibit road machinery in any road show that is not first approved by a joint committee consisting of the executive committee of the Highway Industries Association and the executive committee of the American Road Builders Association. This step has been made necessary by the increasing number of regional shows, and is the more urgent because the primary object of many of these shows is to make profits for the promoters or else to advertise and boost a particular city rather than the road industry. Exhibiting at these various shows, as most of the manufacturers must do since their competitors are exhibiting, has imposed heavy financial burdens upon them.

In the pledge, recognition is accorded the fact that some of the regional shows afford the manufacturer real opportunities for bringing his products to the public notice in a profitable way, by forbidding exhibitions only at such regional shows as are deemed economically unsound by the manufacturers' and road builders' committee. The pledge includes the promise that the manufacturer not only will not himself exhibit but will not permit his agents or distributors to exhibit. The pledge is to go into effect if at least 80 per cent of the membership of the Highways Industries Association signs it, and is to be effective over a two year period beginning with May 1, 1929.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of April, 1929, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1929 to date as of April 27.

	Square Yards Awarded During April, 1929	Square Yards Awarded from Jan. 1, 1929 to April 27, 1929
Roads	12,315,070	22,918,883
Streets	3,981,900	9,797,420
Alleys	357,099	640,022
Totals	16,654,069	33,356,325

Sand and Gravel Plant Equipped With Anti-Friction Bearings

The new plant under construction for the Van Camp Sand & Gravel Company, Lebanon, Ohio, (near Cincinnati) by the Milburn Machinery Company of Columbus, Ohio, will have a capacity of 300 cu.yd. of washed gravel per hour. The machinery is being built by the Smith Engineering Works, Milwaukee, Wis. Every piece of machinery in the plant will be equipped with anti-friction bearings. This is believed to be the first time in the history of gravel plant equipment where a plant's complete machinery has been so equipped. Another feature of the plant is an installation of nine cylindrical concrete silos; two of the crushers and all the washing screens are located on top of the silos.

Business Notes

THE STEARNS-ROGER MANUFACTURING COMPANY, Denver, Colo., announces that in addition to its engineering, manufacturing and contracting business, it will hereafter act as agent in the Intermountain territory for the Chicago Pneumatic Tool Company, of New York.

NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., announces one of the largest factory extension programs in the East. The new buildings for the manufacture of New Departure ball bearings will add 250,000 sq.ft. of floor space to the main works at Bristol and approximately 80,000 sq.ft. to the Meriden plant. The new addition to the forge plant at Bristol has just been completed, adding 25,000 sq.ft., so that the total of increased floor space within the year will reach 355,000 sq.ft., or slightly more than eight acres.

GEORGE HAISS MANUFACTURING COMPANY, INC., announces the appointment of the Equipment Company, Boston, Mass., as its distributor in eastern Massachusetts, Rhode Island and the southeastern part of New Hampshire. It is also announced that the J. L. Hart Machinery Company, Tampa, Fla., is to cover the northern and eastern part of Florida.

DAYTON-DOWD COMPANY, Quincy, Ill., announces the appointment of D. C. Elphinstone, Inc., 120 South Calvert St., Baltimore, Md., as district representative. The pump division sales will be in charge of W. C. Reamy, Jr.

THE FOOTE COMPANY, INC., Nunda, N. Y., manufacturers of road pavers, has announced that F. L. Dake, formerly secretary-treasurer, has become president and secretary, and R. E. Brooks, vice president and treasurer. C. E. Foote and H. M. Foote, formerly president and vice-president, are retiring. Mr. Dake has been associated with the Foote organization since 1906 and has been secretary-treasurer and general manager since 1918. Mr. Brooks is well known as the organizer of the R. E. Brooks Company, 50 Church St., New York City, dealers in contractors equipment, which organization he effected in 1906, later selling out his interest in 1925 to become executive secretary of the Colgate University Alumni Corporation. Since resigning from this position early in 1928 Mr. Brooks has been acting as a special representative for the Paving Mixer Manufacturers Association. Under the new arrangement Mr. Dake will continue in charge of manufacturing and Mr. Brooks will be in charge of sales. The change of organization is announced as being effective immediately.

WILLIAM C. DICKERMAN, since 1919 vice-president in charge of operations of the American Car & Foundry Company, has been elected president of the American Locomotive Company. William H. Woodin, the retiring president, remains as chairman of the board of directors. During the World War Mr. Dickerman was in charge of the division of the company which successfully executed munitions contracts by the American Car & Foundry Company, the contracts being great enough in their aggregate to rank the company third among the organizations supplying munitions of war.

New Developments

Airplane Hangar Doors for Wide Span Openings

A special door for airplane hangars in which limited space is available for operation of the door units in opening and closing has been developed by the Truscon Steel Company, Youngstown, Ohio. The door is applicable to any kind of hangar construction and it may be used on any size of door opening. The frame of the door is of heavy gauge tubular copper alloy steel mitred and reinforced at the corners and electrically welded at all joints; structural steel shapes may be substituted for tubes in

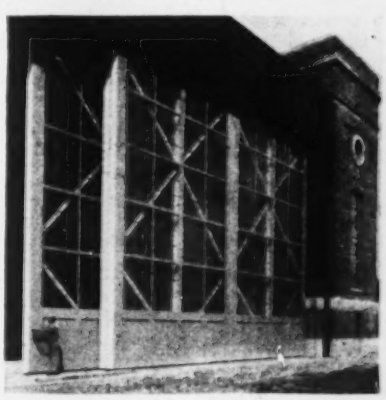


FIG. 1—HANGAR DOORS ON WRIGHT FIELD ASSEMBLY BUILDING, GREENE COUNTY, OHIO

the frame is desired. The lower sections of the doors are solid steel panels and any desired area may be built of standard steel window sections.

These new hangar doors are not suspended from overhead tracks but are equipped with Timken roller bearing

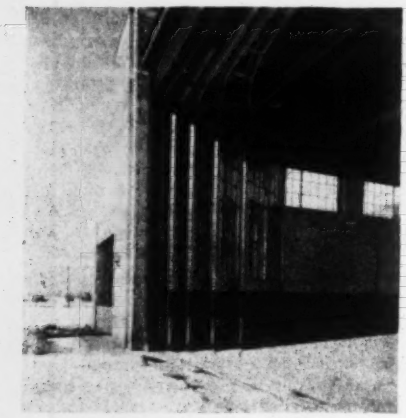


FIG. 2—DOORS ON THE FORD AIRPLANE HANGAR, LANSING, ILL.

trucks operating on tracks embedded in the concrete floor. Alemite lubrication maintains the trucks in easy operation. A light guide rail at the top insures accurate alignment without adding to the weight.

The doors are made to operate in either one of two ways. One involves the use of straight slide doors which, when opened, disappear into towers or other auxiliary portions of the hangar structure. This arrangement leaves the entire hangar opening unobstructed. The second type of doors fit against the sides of the hangar near the opening and are said to be preferred where the plan of the building does not provide for the opening of the straight slide doors and where there is no objection to narrowing slightly the door opening by storing opened doors at the sides.

New Drill for Foundation Testing

A new testing drill known as the Empire hydraulic testing drill has been developed and will be manufactured by the New York Engineering Company, 75 West St., New York City. The drill has been designed for the use of engineers and contractors in road and bridge building foundation and other types of testing work. The drill uses a 2⅝ in. special seamless casing, inside of which a 1¼ in. drill tube is placed. As shown

in the accompanying illustration, a platform is mounted on the top of the casing and the men working the outfit stand on this platform, so that their weight will aid in the sinking of the casing. The photograph shows the drill in use by the Vermont State Highway Commission during the winter when it became necessary to make immediate plans for rebuilding bridges destroyed by the flood. The drill is light in weight and can be easily transported by hand to the site of operation. It is said that borings were made to a depth of over 200 ft. with one of these drills for the State Highway Commission of Louisiana at the site of the Lake Pontchartrain bridge.

New Asphalt Product for Sewer Pipe Joints

An asphaltic product known as No. 1 Korite has been developed by the Standard Oil Company (Indiana), Chicago, for making leak-proof sewer pipe joints. It is claimed that the material forms a permanent joint that will resist pressure, and ordinary alkalinity and acidity of sewage. The No. 1 Korite is put up in light metal cylindrical drums containing approximately 400 lb. each. In using No. 1 Korite, it can be chopped up and melted in a suitable kettle, the temperature required being from 250 to 350 degrees F.

Sewer pipes must be dry and clean when the joint is formed. In making the joint the outside of the spigot end of the pipe and the inside of the bell are swabbed with a thin coating of hot Korite which is allowed to stand for approximately 15 minutes. The pipe is then lowered to the trench, put together in the usual manner and is tightly caulked in the face of the joint, leaving at least 1½ inches of open space for sealing with the material.

Locomotive Cranes Designed for Gasoline and Diesel Power

A complete line of locomotive cranes designed especially for gasoline engine, diesel engine or electric motor drive, to be known as the type "L" crane, has been developed by the Link-Belt Company, Chicago, Ill. It is emphasized that these cranes are not merely modified steam cranes but are designed throughout for the entirely different and much more severe conditions imposed by a power unit running continuously at its full operating speed.

The machinery and its arrangement are particularly adapted to direct engine or motor drive, and all clutches, brakes, shafts, bearings, gears, etc., are oversize in order to give the best operating results. The drive from engine or motor is a totally inclosed silent chain drive, and all upper frame gears have machine-cut teeth. These are claimed to contribute to quiet, smooth operation.

The cranes are furnished with two-speed travel gear which is entirely separate from the other gears used for hoisting, boom hoisting and rotating.

Construction, Labor and Material

E. N.-R. Index Numbers

Cost			Volume		
May 1, 1929	**205.15**		**April, 1929**		**332**
Apr. 1, 1929	203.40		March, 1929		382
May 1, 1928	207.00		April, 1928		316
Average, 1928	206.78		Average, 1926		287
Average, 1927	206.24		Average, 1927		263
1913	100.00		1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of May 9, with some comparisons, total as follows:

(In Thousands of Dollars)

	May 9, 1929	May 2, 1929	May 10, 1928
Building:			
Industrial	$35,645	$5,522	$4,259
Commercial	33,117	28,726	34,467
Streets and roads	21,639	19,066	16,657
Other eng. constr.	16,886	9,729	21,066
Total	$107,287	$63,043	$76,449
Total, all classes, Jan. 1 to May 9:			
1929			$1,608,481
1928			1,232,851

Public Financing Lowest in Seven Years

Permanent long time financing by states and municipalities in April totaled $80,984,136, compared with $129,860,983 in April, 1928, according to the *Daily Bond Buyer*. This is the smallest April total since 1920, in which year new issues amounted to only $63,102,486.

The amount of bonds sold during the first four months of the current year reflects the marked decline of new municipal financing, which has been evident for the last six or eight months. The four months' figure is $352,066,195, compared with $498,621,713 for 1928, and is the lowest total since 1923.

Total state and municipal bond issues reported approved during April was $37,963,300 (covering the improvement programs of 227 municipalities), compared with $77,465,239 in April, 1928, and $75,778,049 in 1927. Of the 227 authorizations, 70 were for school district improvements.

Issues defeated totaled $70,790,370 compared with $96,011,900 in April, 1928, and $17,382,822 in 1927. The large total of rejected issues is due to a proposal to authorize $54,000,000 subway bonds for Detroit which was defeated at an election on April 1. (*Engineering News-Record*, April 4, 1929, p. 564.)

Some recent typical offerings are presented in the accompanying table.

	Amount	Interest	Yield
Flint, Mich., school	$1,100,000	4½	5@4.35
Guilford Co., N. C.	605,000	4½	5@4.55
Milwaukee Co., Wis., sewers	1,150,000	4½	4.25
Paterson, N. J.	1,700,000	5½	5
Syracuse, N. Y.	1,500,000	4@4½	4.10@4.75
Union Township, N. J.	1,000,000	6	5
Ventnor City, N. J.	274,000	5½	4.90
British Columbia, Can.	6,056,000	5	5